LIVELIHOODS AND VULNERABILITY TO RAPID-ONSET NATURAL HAZARDS: THE CASE OF HURRICANE MITCH

by

Peter Loebach

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The dissertation of **Peter Loebach**

has been approved by the following supervisory committee members:

Kim Korinek	, Chair	**5/20/2015** Date Approved
Andrew Jorgenson	, Member	**5/20/2015** Date Approved
Michael Timberlake	, Member	**5/20/2015** Date Approved
Ming Wen	, Member	**5/20/2015** Date Approved
Haimanti Bhattacharya	, Member	**5/20/2015** Date Approved

and by **Kim Korinek** , Chair/Dean of

the Department/College/School of **Sociology**

and by David B. Kieda, Dean of The Graduate School.

ABSTRACT

Anthropogenic climate change presents a pressing need for a deepened understanding of the factors contributing to vulnerability to natural hazards. This study contributes to understanding of the social dimensions of rapid-onset natural hazards by addressing the following research questions: How have historical developmental processes shaped hazards vulnerability? What are mechanisms underlying household vulnerability to rapid-onset hazards? How do large-scale, rapid-onset natural disasters influence long-term development outcomes for subjected communities? This study's first empirical analysis focuses on livelihoods as mechanisms of household resilience from Hurricane Mitch, utilizing the Nicaraguan Living Standards and Measurement Survey (LSMS). Findings indicate specific livelihood profiles to variably predict long-term recovery of disaster impacted households, with households reliant upon agricultural wage production exhibiting a lowered improvement in condition in comparison with households reliant on other livelihoods. This study's second empirical analysis, examining the hurricane's influence on international migration, finds international migration following Hurricane Mitch to be associated with heightened positive selectivity according to capital access. Although these specific livelihood related resilience mechanisms indicate resilience to be associated with high levels of capital ownership, analysis of recovery outcomes at the municipality level indicates a reduction in poverty in impacted communities and increases in consumption shares of those in lower consuming

segments. The findings of this study's separate analysis, which appear at odds, are reconciled in discussion of other likely influencing factors.

TABLE OF CONTENTS

LISTS OF TABLES

Tables

CHAPTER I

INTRODUCTION

Study Introduction

Consensus in the scientific community now exists in support of anthropogenic climate change as a real phenomenon (Intergovernmental Panel for Climate Change [IPCC], 2013). The Intergovernmental Panel for Climate Change cites as evidence of the reality of climate change, alteration of mean global and regional surface temperatures, increased concentrations of greenhouse gases in the atmosphere, variation in sea levels, changing ocean acidification, loss of ice and increased prevalence of extreme weather and climate events (IPCC, 2013). The IPCC estimates that increased occurrence of extreme weather including heat waves, extreme precipitation events, droughts, and cyclones, has already occurred and will continue to do so in the future (IPCC, 2013). Determining what climate change implies for present and future weather patterns, and what novel weather abnormalities climate change will contribute to producing in the future, is the domain of scholars in the natural and physical sciences. However, what changes associated with climate change imply for international governance, for processes of development, and for the living conditions of the populations of the world, are pressing questions deserving of the attention of scholars of the social sciences.

A hazard is an event defined according its potential to bring injury, loss of life, damage to property, or contribute otherwise to social and economic disruption (Fussel,

2007; United Nations [UN], 2004). The existence of hazards, of course, predates climate change as hazards have always been features of human-ecological systems. Global climate change, however, implies change and heightened exposure to certain hazards. While a hazard is defined according to its potential to result in negative impacts, a disaster is defined by the occurrence of severe negative impacts. According to the IPCC, a disaster is defined as:

> severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery (IPCC, 2012, p. 5).

Whether a hazard transitions to becoming a disaster is dependent on two aspects of a community or group at risk of a disaster. First, the degree of exposure to a hazard that a community or group experiences must be so great that the hazard cannot be absorbed without minimal resulting impacts (IPCC, 2012; Joseph, 2013). Second, given that a group or community experiences impacts from a hazard, the hazard only transitions to being a disaster when response and recovering efforts are insufficient in halting severe negative consequences (Adger et al., 2005). These two qualities of a community or in relation to natural hazards are captured in the concepts of vulnerability and resilience, which refer broadly to characteristics of groups or populations that determine likelihood of being subject to a disaster.

The concept of resilience originated within the field of agroecology. Variation exists in its specific definition within the agroecology field, but broadly conceived, it refers to the ability to absorb and/or recover from a disturbance of some sort (Folke, 2006). The concept has been transferred to social science studies of groups and

communities where it refers to capability to adapt without losing functionality, given a shock's occurrence (Perrings, 2006). It has become a prevalent concept in the social sciences, hand-in-hand with the concept of sustainability (Deshingkar, 2012; Levin et al., 1998). Scholars variously separate or integrate vulnerability and resilience as analytical concepts, with some conceptualizations of vulnerability including both coping capacity as well as likelihood of exposure (e.g., Birkman, 2005; McCarthy & Canziani, 2001; Wisner et al., 1994). Alternatively, others delimit vulnerability to likelihood of exposure only, while designating coping capacity as solely the domain of resilience (e.g., Bollin & Hidajat, 2006). The present study follows the frequently cited formulation of Wisner et al., (1994) that inclusively defines hazards vulnerability in terms of both exposure and coping capacity. Vulnerability is defined according to this conceptualization as:

> the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is put at risk by a discrete and identifiable event in nature or in society (Wisner et al., 1994, p. 9).

Society-environment interactions have been a topic of sociological interest from the field's inception. Karl Marx, directly addressed two of the topics that remain the central concerns of present-day social sciences scholars of natural hazards—unsustainable strains placed on the environment by human populations, and uneven vulnerability to hazards according to social position. Marx posited that capitalist development creates a disruption in the exchange between social and natural systems that is unsustainable and implies an eventual ecological crisis, a theory that presaged the increasingly tenuous human-environmental conditions within the context of human-induced climate change being experienced today (Clark & York, 2005; Marx, 1996).

Marx too, was interested in social vulnerability as a feature of societies. Although Marx's attention to class divisions in vulnerability and resilience was principally focused on social vulnerability within the context of fluctuations of capitalist markets, Marx did also note social vulnerability vis a vis the natural environment. On the Irish potato famine of 1846, Marx stated, "[that] it killed more than 1,000,000 people, but it killed poor devils only. To the wealth of the country it did not the slightest damage" (Marx, 1996). Marx's acknowledgement of the environment as a factor influenced by, and interacting with, developmental processes suggests study of developmental processes without accounting for the environment risks ignoring what might be the most important interacting factor of all.

This study continues the tradition of sociological inquiry of environmental topics, with a goal to advance the field by making connections between subfields that have remained disparate. Addressing Robert Stalling's (1998, p. 144) "call for a return to fundamental sociological questions answerable by the empirical study of disasters" this study addresses the following "fundamental" sociological topics: the nature of global social change; social divisions in access to resources; inequality in developmental processes; and individual agency in the context of social structural constraints. This study examines these topics in relation to the operation of hazards resilience and vulnerability in the context of the devastating 1998 Hurricane Mitch event that severely impacted the Central America region.

The specific site of this case study is the developing country of Nicaragua. Examining the impacts of a disaster in the context of a developing country is apropos for adding insight into potential negative implications of global climate change as the

impacts of climate change are predicted to be disproportionately borne on populations of the Global South (IPCC, 2012). This is partially due to a higher vulnerability of developing countries to hazards generally, as exhibited in high rates of fatalities and high proportions of economic losses associated with disasters in developing countries (IPCC, 2012). This vulnerability of developing regions to natural disasters derives from several reasons. One is a high level of livelihood dependence on climate sensitive economic sectors, including rain-fed agriculture (UNISDR, 2011). This dependence implies reduced resilience given that the form of an event results in a high toll taken on agricultural systems. Also, developing countries are typically lacking in economic, technological and human capacities associated with high levels of economic development (IPCC, 2012). Institutions that play key roles in providing buffers against exposure to hazards through the provisioning of infrastructure and regulations, often have limited functionality in the context of developing countries (Raschky, 2008; Toya & Skidmore, 2007). Also, while well-developed institutions may provide effective formalized systems of responses that greatly enhance resilience, poorly functioning institutions offer little. A final feature of developing countries that predisposes them to hazards vulnerability are patterns of human settlement associated with underdevelopment. Settlement patterns in developing countries often feature high population densities in overpopulated megacities, along with populations living contiguously to degraded natural environments (Wisner et al., 1994).

The specific form of a hazard that Hurricane Mitch represents makes this event an apt setting for the study of hazards anticipated to become increasingly prevalent as a result of climate change. A growing scientific concensus agrees that global climate is

directly linked to hurricanes featuring heightened size, severity, and increased intensity of associated rainfalls (Adger et al., 2005; IPCC, 2012). Hurricane Mitch is estimated to be the most deadly hurricane to hit the western hemisphere since The Great Hurricane of 1780 (NOAA, 2009). The negative impacts of the Hurricane Mitch event were experienced across multiple countries within the Central America region, as extreme rainfall associated with the event was experienced miles away from the hurricanes eye. The countries of Nicaragua and Honduras were the hardest hit by Mitch, where the rainfall caused severe flooding, enormous landslides, and heavy river currents (NOAA, 2009).

The eye of Hurricane Mitch did not make landfall on the country of Nicaragua, yet Nicaragua experienced some of the most severe impacts of the event. Estimates place the rainfall intensity associated with Hurricane Mitch in Nicaraguan to severity not experienced for at least 500 years (USAID, 1999). Hurricane Mitch's direct impacts in Nicaragua include 3,000 killed (Steele, 2001), over half a million rendered homeless, and extensive damage to infrastructure and land. Estimates of combined direct and indirect losses for Nicaragua, attributable to the event exceed over $1 billion (Guha-Sapir et al., 2004). Much of the severe economic impacts of the event on the country relate to damage to agriculture. Within the North Atlantic, North Pacific, and North-Central regions, heavy losses of export crops occurred, including coffee, sesame, sugar cane and peanuts, along with losses of basic sustenance crops including grains, tubulars, bananas and vegetables (ECLAC, 1999).

As outlined above, there are numerous aspects of the Hurricane Mitch event that make it a compelling context for the study of vulnerability in relation to hazards likely to

arise from human induced climate change. It would be withholding, however, to claim these alone as the factors determining this site as the subject of this study's empirical analyses. An important factor that influenced the decision to study in detail the impacts of Hurricane Mitch as experienced in Nicaragua is the availability of detailed and rich data that permit exploration of a range of specific household and community level characteristics and their relation to Hurricane Mitch. Defining elements of disasters—the disorder and destruction they bring—make the social dimensions of disasters intrinsically difficult to capture with quantitative measures (Bensons, 2008). Further, the problem of data collection surrounding disaster events is compounded within the context of developing countries in which institutions and capacities are stretched exceedingly thin. For these reasons, these panel data, preceding and following for years after the occurrence of a large-scale disaster, present a rare opportunity to study an array of aspects related to hazards vulnerability.

Data Source

The Living Standard and Measurement Survey (LSMS) was first conducted in in 1985 under the implementation of the National Institute for Statistics and Censuses (INEC) with the support of the World Bank (WB). The quality of the data derived from this initial survey wave are dubious for a number of reasons (Wiggins, 2007)—a principal one is that when survey responses were compiled into a data set, geographic differences in prices were left unadjusted, an especially problematic oversight in the context of the dramatic and wide inflation rampant at the time. Subsequent data collection waves were conducted in the years 1993, 1998, 1999, 2001, 2005 and 2009. Unlike the data collected during the 1985 survey wave, surveys during these later periods utilized sophisticated and

effective sampling techniques and applied price factors to account for geographic economic variation. These data have been put to a good deal of analyses and yielded numerous significant works (e.g., Jakobsen, 2012; Van den Berg, 2010; Van den Berg & Burger, 2008; Wiggins, 2007).

The third wave of the Nicaragua LSMS was conducted in the middle months of the year 1998 (Steele, 1998). The survey conducted at the level of the household addressed the topics of demographics of household members, sources of income, health of household members, migration histories, and ownership of a range of assets and capitals. Hurricane Mitch struck in November of the same year. Officials at INEC took advantage of the opportunity to build a panel data set that examines the condition of households both prior to and following the occurrence of Hurricane Mitch and organized a post-Mitch data collection wave (Steele, 2001). INEC had two criteria for inclusion of households in the 1999 collection wave. First, they must had been surveyed in the 1998 data collection wave. Second, INEC surveyed only those households residing in communities heavily exposed to the hurricane, as there was wide variation in degree of exposure to the Mitch event across the country (World Bank [WB], 1998). In the months of May and June of 1999, this survey was conducted. The questions asked in the 1998 data wave were reproduced in the 1999 data waves, as were additional added questions pertaining directly to Hurricane Mitch, including whether the household had been damaged by Mitch, and whether the household had received any recovery aid. In total, 595 households were surveyed in the 1999 round, 429 of which resided in rural communities.

Successive data waves in the years 2001, 2005 and 2009 have continued to follow

households surveyed in previous waves. New households have also been incorporated into the sampled population. Attrition has occurred, albeit to a moderate degree. Of the 595 households surveyed in 1999, attrition into the years 2001, 2005, and 2009 waves was 19 households. However, sensitivity analysis performed in Chapter III finds no bias associated with this attrition.

In sum, the Nicaragua LSMS supplies a rich data source that offers a rare opportunity to study hazards resilience as a process unfolding over an extended period of time through examination of the condition and activities of households over a 10 year period spanning the occurrence of the Hurricane Mitch event.

Study Outline

A first goal of the present study is to place the topic of natural hazards within the context of global developmental processes by introducing sociological development theory to the topic of natural hazards. It has been acknowledged that while the study of hazards is an inherently sociological topic (Stalling, 1998), and a sociological subfield unto itself, this subfield has remained marginalized within the discipline of sociology (Tierney, 2007). This marginalization has been detrimental to the development of a full understanding of the natural hazards and their relation to core sociological questions, including inequality as related to developmental processes (Hilthorst & Bankoff, 2008; Stalling, 1998). Chapter II, "Depeasantization and the Development of Disasters Vulnerability" seeks to address this lacunae by demonstrating how aspects of hazards vulnerability have grown out of developmental processes. First, the chapter highlights the dissolution of the premodern "moral economy" or "subsistence ethic," the systems of norms, relationships and practices surrounding peasant communities that operated

according to a logic of survival and subsistence over market efficiency (Thompson, 1971; Scott, 1976; Wolf, 1969). With capitalist relations, norms and values of market efficiency replaced the moral economy, a shift in social practices that implies the loss of mechanisms that aided in reducing hazards exposure and contributed to the resilience of the peasantry (Polanyi, 1944; Wolf, 1969). Second, the depeasantization literature highlights that a distinctive feature of modern developmental processes is a movement out of subsistence agriculture and changes in the resources available to the rural poor. These various alternative sources of income that have increasingly come to replace agricultural subsistence in rural areas of the Global South have not become equally available across socioeconomic divides. As vulnerability and resilience fundamentally relates to the ability to draw on resources to respond to shocks, changes in resources and livelihood options imply change in disaster vulnerability. I argue that for the relatively wealthy segments of rural populations, the introduction of novel livelihoods has resulted in increased income, diversified across a range of sources; the condition of the poorest segment of rural areas of the Global South, in contrast, has grown increasingly tenuous.

Chapter III examines a proposition alluded to in Chapter II—that livelihoods are central determinants of hazard resilience. According to the rural livelihoods framework, livelihoods are strategies engaged in by households to provide for their basic needs, within the constraints of capital access and contextual factors (Chambers & Conway, 1991; Scoones, 1998). The rural livelihood framework has from its inception acknowledged livelihoods as potential mechanisms of hazards resilience (Chambers & Conway, 1991:1). Yet empirical examination of how livelihoods operate as determinant of hazards vulnerability independent of the influence of poverty is only a very recent line

of inquiry (Speranza et al., 2014; Van Den Berg, 2010).

The empirical analysis performed in Chapter III examines differentials in disaster recovery outcomes by household livelihood portfolios utilizing data from the Nicaragua LSMS. To operationalize household livelihood practices, occupations of household members are grouped into categories that include economic sectors, ownership of productive means, and migration. Hierarchical agglomerative clustering is then used to derive categories of predominant livelihood portfolios of households to which every household is assigned. To examine how these livelihood categories predict resilience, random effects longitudinal regression is utilized to regress change in ownership of household assets on household livelihood categories, a variable that designates households having experienced damage from the disaster, and interaction effects of the disaster variable with each livelihood category variable.

Chapter IV continues the topic of household livelihoods in the context of natural disasters, but with emphasis on one particular livelihood strategy, the use of the selective migration of individuals from households as a means to diversify income sources. This particular livelihood strategy is relevant to discussion of the implications of global climate change on human movements. As the once widely used term "environmental refugee" has become recognized as a simplistic mischaracterization of the influence climate change may imply for human mobilities, recognition has been made of a need for investigation of a diversity of pathways by which environmental disruptions yield human migrations.

I argue in this section that the new economics of labor migration (NELM) model pioneered by Lucas Stark is useful for explicating the causal logic behind one particular

form of migration in response to natural hazards. According to the NELM model, households residing in rural underdeveloped areas utilize the select migration of individual members of the household as a livelihood strategy to diversify risk and smooth income in the case of shocks—shocks due both to price fluctuations in integrated markets, and to the vagaries of nature (Julca, 2011; Stark, 1991). Also, this section emphasizes a central point recognized by the rural livelihoods framework—that livelihoods are constrained by access to capitals. This study asks two questions in regards to migration following Hurricane Mitch: Did the Hurricane Mitch event induce an increase/decrease in international livelihood migrations from Nicaragua? Are selectivity patterns in the context of the event indicative of migration as a last-resort pursued by the relatively vulnerable, or instead, an adaptation strategy of the highly capable?

Data from the 2001 LSMS wave are utilized to model migration likelihood over a 6 year period spanning the Hurricane Mitch event. The central dependent variable representing international migration explicitly for the purpose of work is derived from questions asked of household heads in the 2001 data waves. The two questions inquiring of prior migrations read: "Is there someone who lived in this home who currently lives in another country"; and "In the last 12 months did a member leave the municipality temporarily for work purposes" (Government of Nicaragua, National Institute of Statistics and Censuses [INEC], 1998). Based on this question and a follow up inquiry of the year of a migration's occurrence, household migration histories between the years 1996 and 2001 are constructed. Event history analysis is then utilized to model migration likelihood to examine the influence of living in a Mitch affected community on

likelihood of migration and possible interplay between living in a Mitch area and migration selective characteristics.

Recognition has been made that hazards associated with global climate change may a pose serious threat to the possibility of development for vulnerable countries and communities (IPCC, 2007; Yamin et al., 2005). Chapter V seeks to examine if the Mitch event played a role in influencing central developmental outcomes associated with broad processes of development—specifically, inequality and poverty. Although much attention has been paid to macrolevel associations between hazards and specific development characteristics, including strength of institutions (Lin, 2014; Neumayer et al., 2014) and level of economic development (Kahn, 2005; IPCC, 2007; Toya & Skidmore, 2007), relatively little examination has been conducted on how environmental disruptions feedback on macrolevel characteristics to influence development outcomes (Bui et al., 2014).

Vulnerability in all its forms, including the mechanisms of vulnerability examined in Chapter II, III and IV imply worse impacts of disasters according to social position. Still, does vulnerability translate to lasting differential effects of hazards on population segments observable to the macrolevel that need to be considered as important factors shaping development outcomes? These are the central questions motivating Chapter V's analysis.

To examine levels of poverty and inequality in the context of Hurricane Mitch, the unit of analysis is shifted from the household to the level of the municipality. At the level of the municipality, this study examines if the Hurricane Mitch event was associated with change to the following indicators: rates of poverty, the consumption distribution as

measured according to quintiles, and the Gini coefficient measure of inequality. Random effects longitudinal regression models are estimated for each of these indicators. Exposure to the Mitch event is captured with a binary variable representing areas heavily exposed to the Mitch event, as designated by the INEC and a difference-in-differences specification is utilized to the influence of this variable. The time points for collected data are the years 1998, 2001 and 2009. In addition, predictive variables associated with the internal development model are included in the predictive model to account for factors associated with time and level of development that are influential on macrolevel outcomes.

Chapter V concludes the study by summarizing the study's findings and discussing contributions made to the field of sociology, migration studies, the interdisciplinary hazards field, and to our understanding of the implications of global climate change.

CHAPTER II

DEPEASANTIZATION AND THE DEVELOPMENT OF DISASTERS VULNERABILITY

Introduction

Over the last 30 years an increased global awareness of natural disasters has developed worldwide (Brunsma & Picou, 2008). This awareness is partly the result of an increasing number of people affected by disasters annually and partly to the development of a global mass media that rapidly disseminates knowledge of the devastation wrought by disasters. With the development of this "consciousness of catastrophe" (Brunsma & Picou, 2008), scholarship of natural disasters has grown. Yet, within the sociology discipline, hazards scholarship has remained a marginalized subfield, its theory unconnected to broader sociological discourses (Oliver-Smith, 1998; Tierney, 2007; Williams, 2008).

Kathleen Tierney (2007) posits that the theoretical underdevelopment of the field stems from a problem-solving, applied scholarship orientation that became ingrained during the field's foundational years. The research questions of the field's founders centered around the imperative of reducing human suffering as a result of natural hazards through an understanding of the social dynamics surrounding disasters' occurrences and the postdisaster recovery process. Subfield founders, Quarantelli and Dynes described and categorized the social behaviors and processes observed to be common to disaster

events not merely to develop understanding of the social world, but to identify the social dynamics that are relevant for best practices to protect against the occurrence of hazard events and to effectively respond to occurred events. While scholarship within the subfield has expanded and the topics of disasters study have broadened, an atheoretical, ahistorical undercurrent persists in sociological study of natural hazards (Bankoff et al., 2008; Letukas, 2008; Norris et al., 2002).

This chapter explicates historical developmental processes that played fundamental roles in shaping the patterns in the vulnerability of specific groups to hazards that are observable today. This section does so by introducing the sociological concepts of the moral economy and depeasantization, both theoretical concepts that shed light on shifting ways of life and livelihoods for agrarian populations with capitalist integration. I argue that these shifts hold implications for the vulnerability of rural agricultural producers.

This chapter is organized as follows. The immediately following section titled "Hazards Vulnerability" reviews the place of development in the interdisciplinary, hazards vulnerability literature. The succeeding section, "Vulnerability and the Transition to Global Capitalism" examines the evolution of hazards vulnerability and resilience that occurred with the transition to capitalism. A fourth section, titled "Depeasantization: New Resiliencies, New Vulnerabilities" examines increased vulnerability in the context of 20th century economic developments. "Discussion and Conclusion" concludes this study with a broad discussion of the evolution of hazards vulnerability in historical perspective.

Hazards Vulnerability

"Naturalist" approaches to the study of natural hazards conceive of disasters as exogenous acts of nature that impact human societies. Though extraordinary natural events are conceptualized as exogenous, the damage inflicted by disasters is not viewed as random; rather, human societies can buffer themselves against natural events through the use of technology and knowledge to predict, prevent and mitigate against their occurrence (Joseph, 2013). Past and current research in this tradition consists largely of technological and scientific assessments predicting the occurrences of disasters in order to develop management techniques to mitigate against their future occurrences. Though a central assumption of this perspective is a discrete separation of human society and the natural environment, it relates disasters to social development in that disasters are understood as more likely to severely affect premodern societies lacking "modern" techniques and technologies that could be utilized to mitigate against natural hazards (Hilthorst, 2008; Joseph, 2013). Such an understanding of societal development is consistent with modernization theories of social development that conceive of a linear progression from traditional, premodern societies to advanced societies characterized by high levels of human capital and well-functioning institutions (Harrison, 1985; Inkeles & Smith, 1974; Rostow, 1960).

The vulnerability approach emerged in critique of the naturalist approach. Multiple schools of hazards vulnerability have developed, with differing points of emphasis, but the following themes are overarching (Fussel, 2007). As opposed to viewing hazards as discrete forces that impact human societies, vulnerability analysis conceives of an interwoven environment, society, individual relationship. Instead of

occurring exogenously, hazard events are instigated by social activities (Hunter 2005; Wisner et al., 1994). Population settlement, expansion, urbanization, mining, deforestation, damning, migration, carbon emission—all are social activities that impact the natural environment and in so doing, change the nature of the population and environment relationship. In addition to hazards being instigated by human activities, exposure and resilience characteristics of a group or community influence the likelihood of a hazard becoming a disaster (Dynes & Drabek, 1994; Williams, 2008). In demonstration of this point, Albala-Bertrand's meta-analysis finds the extent of damage inflicted by a disaster is determined more by community context than disaster size. Specific community level correlates with disasters that scholars have identified include income per capita, education, trade openness, development of financial and political institutions and systems of governance (Kahn, 2005; Kellenberg & Mobarak, 2008; 2011; Raschky, 2008; Toya & Skidmore, 2007).

The vulnerabilities framework represents significant theory advancement for the hazards scholarship field and the approach has made important contributions in the arena of applied sociology. Disaster scholarship utilizing this framework has been utilized for important political advocacy, as understanding of vulnerability has formed the basis of criticism of recovery management models that have failed to take into social context, have excluded the affected from recovery planning and neglected the needs of critical populations. However, while the vulnerability framework represents significant advancement beyond a dichotomous understanding of populations and disasters, it suffers from the pragmatism, ahistoricism and lack of theoretical integration characteristic of the broader sociology of disasters subfield. As described by Hilthorst and Bankoff, "A

proper appreciation of the construction of vulnerability is still often hampered by the lack of an adequate historical perspective from which to understand the contexts and roots of disaster causality" (2008, p. 3).

Kathleen Tierney posits that theoretical advancement of the disasters subfield could occur through integration of the sociology of disasters with the proximate subfields of environment, risk, organizations and political economy. Indeed, recent scholarship that has followed this prescription by applying sociopolitical theory to the study of disasters has been productive for the field, yielding novel insights into polity form as determinant of disaster impacts (Lin, 2014; Neumayer et al., 2014). I suggest that Marxian influenced perspectives within the sociology of development could be useful in developing the connection between socioeconomic change and hazards vulnerability, as vulnerability and resilience relate to developmental processes that affect the distribution of resources that are necessary for disaster recovery across social strata. By exploring how developmental processes have affected the resources available over time and across social strata, we can better understand the historical nature of disasters vulnerability and resilience. I argue that the historical nature of global disasters vulnerability can be explicated by "bringing class back in" (Bernstein, 2010).

Vulnerability and the Transition to Global Capitalism

In this section I trace the evolution of disasters vulnerability and resilience in rural agrarian communities over the transition from precapitalist to capitalist production systems. Prior to the emergence of capitalism, several systems of production were predominant. In broad strokes, these can be categorized as primitive-communal systems, slave-owning systems, and tribute-paying systems (Amin, 1976; Chase-Dunn, 1998). I

focus here specifically on social systems approximating the tribute-paying system, the most widespread precapitalist form, and the one that encompassed the continents of Europe and Asia (Amin, 1976; Bernstein & Byres, 2001; Byres, 2009). In such systems, those cultivating agricultural land to produce their subsistence paid rent, tribute or tax to the owners of the worked land with a combination of coercion and ideology maintaining the social stratification underpinning these systems. An evolution occurred across such communities that had particular implications for the ability of poorest segments to recover from natural calamities.

Social protections against famines and disasters was one of the fundamental logics of tribute based, precapitalist societies. Systems of norms, relationships and practices surrounding peasant communities in these societies operated according to a logic of survival and subsistence over market efficiency. The "subsistence ethic" (Scott, 1976) or "moral economy" (Thompson, 1971) offered insurance to the peasantry, operating through ownership systems and norms governing social interactions. Expectations of reciprocity abounded amongst peasant populations, serving as powerful redistributive mechanisms. Jealousy, shame, envy and gossip pressured those experiencing abundance to be charitable towards the indigent and those in temporary hardship (Polanyi, 1944; Scott, 1976). Expectations of social obligations towards the stricken were not exclusively amongst the peasantry, as they extended between the classes. The peasant-landowner relationship, though fundamentally exploitive, had a familial, dependent quality. Landholders and rulers were to a degree, paternal figures, morally and religiously bound to their peasants (Bendix, 1977; Thompson, 1971). Under calamitous conditions, the landowner of a given plot bore the costs and losses associated

with damage to land alongside the peasant worker on the given plot. Failure to meet tribute quotas under such conditions were not grounds for dissolution of a landholder-peasant arrangement, as both aristocrat and peasant were permanently bound in a relationship believed to have a divine basis, as opposed to one operating according to contractual dictates (Wolf, 1969).

The distribution and placement of landholdings itself operated according to an insurance against the vagaries of nature logic. Landholder arrangements were not rigidly set as they are in modern conceptions of titleing and private ownership. Under communal land systems, households were responsible for designated plots from which they derived subsistence and tribute. These plots within communal lands were frequently reshuffled and redistributed according to relative need (Scott, 1976)—a disaster event being one such condition that would provoke reshuffling. "Scattering" of plots was also common (Goland, 1993; McCloskey, 1989; 1991). Peasant households' multiple holdings often did not lie contiguously, but instead were erratically dispersed across geographic areas, a phenomenon observed amongst the peasants of England, Peru, Japan, Korea, Ethiopia, Tanzania, Taiwan, Thailand, Pakistan and India (Goland, 1993; McCloskey, 1989; 1991). Working these holdings required arduous, inefficient movement across lands; but in trade-off, this system of dispersed holdings offered holders insurance against calamities impacting agricultural lands that might be geographically contained, whether natural events or pillaging by thieves or wandering armies.

In sum, social protections against the vulnerability of individuals were at the basis of the social order in the precapitalist era. These insurance mechanisms did have

limitations, however. As these mechanisms were based upon redistribution within communities, in the case of larger scale events that severely impacted whole communities, these communal insurance mechanisms were irrelevant. Still, in historical perspective, these insurances mechanisms against the vagaries of nature aimed specifically at the marginalized and vulnerable are distinctive elements of precapitalist agrarian social structures.

These precapitalist social insurance mechanisms eroded over 5 centuries of global economic transformation. Karl Polanyi noted, "It is the absence of the threat of individual starvation which makes primitive society, in a sense more human than market economy, and at the same time less economic" (1944, p. 163-164). Capitalism became the engine of incredible economic and demographic growth. With it, relatively simple social structures generally characterized by a divide between landowning elites and peasant producers became increasingly replaced by complex, differentiated social structures (Mann, 1986; Paige, 1975; Reuschemeyer, 1986).

The transformation of the feudal social order began with the emergence of capitalism in northwest Europe in the late 15th and early 16th century. In the 17th century, commercialized agriculture spread across the globe with colonialism (Anderson, 1974; Marx, 1996; Paige, 1976; Wallerstein, 1974; Weber, 1981). With these transitions to commercialized agricultural production, communal lands became enclosed or seized by the aristocracy and a wide variety of new tenancy and labor arrangements replaced long-standing feudal arrangements (Bernstein & Byers, 2002; Wallerstein, 1974). The enclosure movement ended the communal landholding systems, and with them, the fluid system of landownership that encouraged redistribution of landholdings to those

experiencing destitution. Redistributive traditions were doubly reduced by the development of infrastructure and legal institutions. Infrastructure and technology allowed distances to open and social relations became less tied to a local place, thus defusing the power of local norms that depend on individuals' social identities being tied to a community (Giddens, 1990). Moreover, legal institutions rendered norms encouraging altruism increasingly ineffectual (Scott, 1976). Were a relatively affluent peasant experiencing social pressure to supply charity, he could now ignore these pressures and marshal legal institutions to his defense. Beyond agricultural land, legal property rights became attached to natural resources of all types. Forests and fishing areas, once alternative sources of subsistence that could be turned to by those experiencing destitution, became unambiguously private goods protected by the law (Scott, 1976).

Economic relationships became increasingly impersonal and "disembedded" from social life (Giddens, 1990). The landowner-tenant relationship shifted from the logic of the moral economy to market efficiency, a development that increased the power of the landlord vis a vis the peasant producer (Polanyi, 1944; Thompson, 1976). In the previous order, this relationship was mutually dependent and relatively secure with risk and loss mutually borne by peasant and landowner. Under capitalist markets, as opposed to flexible rent levels determined by variable crop yields, fixed rents owed by peasant sharecroppers were determined according to profit rates determined by yields in robust agricultural harvest years. Were the natural environment to yield a suboptimal harvest, or worse a disaster, rents remained unchanged (Thompson, 1976). The landowner-peasant arrangement, no longer viewed as sealed by a divine order, instead operated according to

impersonal, contractual dictates. Sharecroppers failing to meet contractual fixed rents lost access to land and joined the ranks of landless agricultural wage laborers—one further step away from a secure existence, bracketed by traditional social relations and towards one of vulnerability in the face of vagaries of the modern market and natural environment (Scott, 1976).

Depeasantization: New Resiliencies, New Vulnerabilities

In this section I detail a second historical socioeconomic transformation that occurred, and contributed further to the vulnerability of small agricultural producers. The late 20th century featured intensified global economic integration and a movement towards neoliberal reforms. The accelerated economic integration that marks this period changed the livelihood profiles of rural poor populations. Millions have risen out of poverty and experienced a subsequent reduction in vulnerability (Baghwati, 2007; Milanovic, 2011). For the poorest segments of the rural south, however, this has not been the case.

Depeasantization refers to a change in the social structure of developing communities, beyond the level of the nation-state, which has occurred with global integration. The concept is contested, with principal disagreements surrounding definition of the peasantry as a social group and, consequently, what constitutes its disappearance (Araghi, 1995, 2009; Bernstein, 1996, 2010; Ellis, 2006; Kay, 2006; Johnson, 2004; Vanhaute, 2012). Definitional issues aside, broad areas of agreement exist across scholars regarding changes that have occurred in the condition of the global rural population since the mid 20th century that have implications for the basis of vulnerability and resilience. I draw attention to four empirically demonstrated

developments that have occurred in the Global South since the mid 20th century that have bearing on vulnerability and resilience following hazard events that I collectively refer to as depeasantization.

First is change in the geographic concentration of populations of the developing world in the form of urbanization. Urban migration is certainly not a new population process. Migration in search of livelihoods has been noted as a reaction of the rural poor to economic integration since the 16th century (Marx, 1996; Ravenstein, 1976). Marx noted that the migration of the rural peasantry in England in response to capitalist pressures predicated the development of an urban, wage labour class in English cities. The accelerated rate of urbanization since the mid-20th century is, however, novel. In 1950, 16% of the less developed world lived in urban areas. In 2000, this had increased to 41% (Araghi, 2012). The relative depopulation of the rural areas in tandem with the gross overpopulation of urban areas since the mid-20th century is one defining feature of depeasantization.

Second is a change in the concentration and ownership of capital in rural areas of the world. With economic integration, capital has expanded to rural areas and capital ownership has become increasingly nonindigenous (Bernstein 1996, 2010). One form this nonindigenous capital has taken is investment in industrial manufacturing by highly capitalized firms (Foster & Rosenzweig, 2004; Gereffi & Korzeniewizc, 1994; Mcmichael, 2012a). Nonindigenous capital has also taken the form of outside ownership of rural landholdings. Landholdings of the Global South have become consolidated in a global "land grab" (Borras et al., 2012; Harvey, 2003; Zoomers, 2010), or "new enclosure" movement (White et al., 2012) which has occurred with economically

powerful actors gaining increased ownership of the agricultural lands of the Global South. Partially as a consequence of increased nonindigenous ownership of landholdings, a third aspect of depeasantization has occurred. The landholdings of the rural poor shrunk and landlessness increased (Ellis, 2006; Kahn, 2000; McMichael, 2012a). Demographic increase and the subdivision of lands inherited to children has certainly played a part in this development. However, economic processes are also responsible. Sharecropping arrangements have been increasingly severed with increased capital concentration in rural areas, and sharecroppers have joined the ranks of rural landless populations.

Finally, transformation of livelihood forms in the rural Global South has occurred with reliance on subsistence household agricultural production demonstrating a marked decline (De Schutter, 2011; Hecht, 2010). Diversification of livelihoods has occurred, as household oriented farming alone has become insufficient for provisioning of basic needs for many. One supplement to, or replacement of, household oriented farming is engaging in agricultural work, but in the form of wage-labor, working for the large, highly capitalized agro-industrial firms that have penetrated rural areas of the Global South (De Schutter, 2011; Kay, 2006; McMichael, 2012a). Aside from wage earning in the agricultural sector, nonfarm labor employment has proliferated, taking such forms as road and housing construction, food processing and packaging (Kay, 2006). Comprising 25-30% of incomes of rural populations of the Global South in the early 1980s, nonfarm livelihoods rose to above 40% by the late 1990s (Berdegue et al., 2000:2; Bryceson, 1999; Kahn, 2005; Reardon et al., 2001).

Remittances as a nonfarm livelihood resource in rural areas have demonstrated an

unprecedented boom, more than quadrupling between 1990 and 2005, and surpassing flows of foreign aid and foreign direct investment (Faist, 2008; Gammeltoft, 2002). A migration pattern that has becoming increasingly salient has been the temporary migration of individual members of households to domestic or international destinations while the rest of the household remains located in the home community (Stark, 1991). This migration is a survival strategy of the household in the face of increased economic competition in agricultural communities. In order to generate capital for household investment and to distribute risk, households send select members to become migrants while the rest of the household itself remains located in the home community. Remittances from migrants become a means for basic household maintenance and for investment in small businesses or petty commodity production. This migration is often nonpermanent as the employment on which this migration is predicated is often temporary (Piore, 1979). Beginning in the 1970s and continuing into the present, both permanent, settled out-migration and temporary household migration has increasingly occurred globally, in tandem with broader patterns of global integration (Castles, 2003).

The essentialist critique of the depeasantization framework argues that a uniform agrarian social class does not exist globally, nor has it ever (Mclaughlin, 1998). Indeed, the class structures of rural areas of the Global South are specific, nuanced and far from homogenous (Bernstein & Byres, 2001; Borras, 2009), and so are the socioeconomic impacts of contemporary land grabs (White et al., 2012). Even so, empirical study has demonstrated that a decrease in home agricultural production and concomitant increases in agricultural and nonfarm wage employment have been found to be more than regional development trends. Post the mid-20th century, a rise in nonfarm employment and

diversification of livelihood strategies has been observed across the major regions of the developing world: in Sub-Saharan Africa (Bryceson, 1999; Ellis, 2006), in Latin America (Kay, 2006; Reardon et al., 2008), and in Asia (Rigg, 2006). The forms that nonfarm labor have taken are regionally nuanced. In Latin America, rural nonfarm employment has been estimated to be composed of 41% manufacturing, 24% commerce and 35% services. Asia exhibits a similar distribution with services and manufacturing employment more prevalent than commerce. In contrast, in rural Africa, employment is even across sectors (Reardon, 1998). Although these regional distinctions are notable and make it clear that developmental processes are contextually shaped, the phenomenon of decreased subsistence agricultural production and increased diversification of livelihood strategies is a global phenomenon with broad implications.

A large body of work in the livelihoods literature has yielded much insight into inequality livelihood participation as determined by uneven access to capitals, assets, and resources. (Bebbington, 1999; Chambers & Conway, 1992; De Haan & Zoomers, 2005; Dijk, 2011; Scoones, 1998).

Across regions of the Global South, two trends in access to work in the rural, nonfarm livelihood sector have been observed, both favoring wealthier segments of rural populations. Review of case studies of Latin American and Asian countries have found that a U shaped curve describes the relationship between share of total income derived from nonfarm income sources and household total income (Reardon, 1998; Reardon et al., 2007). Both the poorest and the richest segments participate in nonfarm activities, but they do so in very different capacities and occupations. The relatively wealthy have become the owners of the growing nonfarm self-employment sector (Reardon et al.,

2000; Reardon et al., 2007). Viability in a competitive market requires business owners to utilize capital intensive productive inputs and securing these inputs requires investment capital, not available to the poor, effectively excluding the poor from self-employment opportunities. Employment of the poor in the nonfarm sector consists primarily of engagement in work as wage laborers for industrial firms or in the service sector (Deininger & Olinto, 2001). In contrast to the U shaped relationship observed in Latin America and Asia, a more linear relationship between nonfarm employment and socioeconomic position has been observed in Africa. Survey of household studies conducted in Africa (Reardon, 1997) finds on average, that the share of total income taken up by nonfarm income sources is twice as great in upper income tercile households as in lower tercile households. In Africa, nonfarm income has become the domain of the wealthy as high-paying nonfarm employment and self-employment are highly linked to educational attainment (Barrett et al., 2001).

Migration, too, is a selective livelihood option. Migrants are positively selected according to affluence, though the relationship is nonlinear, with migrants typically of middle, socioeconomic background (Portes & Rumbaut, 2006; Stolz & Baten, 2012). One reason for this positive selectivity is the role played by education in obtaining employment at destination. Second, migration necessitates cost of travel. The ability to bear this cost, and furthermore bear the risk of failing to achieve work at destination, requires investment capital. Lastly, although migrant networks lower the costs and risks of migration, access to these networks is uneven (Brown, 2002; Garip & Curran 2010; Palloni et al., 2001). The positive selection of migrants is consistent amongst migrants to international destinations and the pattern frequently, though not always, carries over in

internal migrations. (Feliciano, 2005; Portes, 1979).

In the agricultural sector, full, or partial participation in agricultural wage employment has become an increasingly relied upon income source for many households (Akram-Lodhi & Kay, 2010; Barrett et al., 2001; Kay, 2000). Small scale land holdings have shrunk, due to multiple reasons including demographic pressures, the expansion of urban areas, erosion and soil depletion, and land grabbing by powerful economic sectors (Bernstein, 2006; De Schutter, 2011; Kay, 2006; Khan, 2005; McMichael, 2012b). Paradoxically, income from nonfarm income sources is required to maintain land holdings under these pressures (Berdegue & Fuentealba, 2011; Davis et al., 2010), and as mentioned, it is the well-endowed with capital and assets that have access to lucrative nonfarm income sources. The vast majority of very poor small-scale agricultural producers are now net food buyers (De Schutter, 2011). Unable to resist the pressures of the land squeeze, and unable to subsist on owned land, they are increasingly relying partially or fully on insecure, low-paid agricultural wage employment.

The global economic integration that marks the period beginning in the late 20th century rapidly altered the livelihood profiles of rural poor populations. Millions have risen out of poverty and developed livelihood portfolios diversified in new sectors (Baghwati, 2007; Milanovic, 2011). For the lowest socioeconomic segments of the Global South, however, this has not been the case. Global development has left them with insufficient land and assets to maintain either a subsistence existence or a livelihood based on petty commodity production. They now heavily derive their livelihoods from wage work, but it is low-level wage work, with little opportunity for mobility or the accumulation of assets. This reliance on low-income wage labor, combined with reduced

size of landholdings, has resulted in an increasingly tenuous livelihood circumstance for the global poor.

These developments have implications for disasters resilience. Opportunities now exist for allocation of wealth, assets and labor across economic sectors, permitting some households to diffuse risk. Access to diverse livelihood profiles is selective, however. The poorest segments do not possess this adaptive capacity. If their livelihoods lie in economic sectors affected by a disaster, they lack a range of income sources in alternative sectors. Coping, for them, involves consuming all savings or drawing limited, costly credit, and instead of recovery, a downward spiral of indebtedness and persistent inability to meet basic needs is experienced (Carter & Barrett, 2006; Carter et al., 2007; Jakobsen, 2012; Van den Berg & Burger, 2008). For those deriving their livelihoods from the agriculture sector, intrinsically responsive to the natural environment, this lack of adaptive ability is perhaps most problematic.

Members of the poorest segment of rural communities of the Global South are in a double bind. Global development has left them with insufficient land and assets to maintain either a subsistence existence or a livelihood based on petty commodity production. Paradoxically, the ability to maintain ownership of agricultural landholdings has been predicated on access to nonagricultural incomes and it is the relatively wealthy who have access to these alternative income sources (Bernstein, 2006; Khan, 2005). The poor, now unable to subsist on subsistence production, nor able to engage in petty commodity production, now depend heavily on wage work, and it is low-level wage work, with little opportunity for mobility or the accumulation of assets (Barrette et al., 2001; Kay, 2000; Akram-Lodhi & Kay, 2010). This reliance on low-income wage labor

combined with reduced size of landholdings has resulted in an increasingly tenuous livelihood circumstance for the global poor. Herring and Argawala describe the condition of this segment in India: "unattached to anyone's land, selling labor power as a commodity in an unpredictable market, often uprooted by pushes and pulls of market forces, and largely without representation" (2006: 344). In sub-Saharan Africa, it is estimated that the livelihood circumstances for all except the top quarter of the population has deteriorated (Ellis, 2006). Tragically, this segment continues to grow globally (Khan, 2000)

Discussion and Conclusion

The dissolution of precapitalist social systems razed feudal resilience mechanisms that favored vulnerable population segments. Local knowledge and practices highly specific to local ecologies and the vagaries of a given environment became lost (Oliver-Smith, 1998; Thaman, 2002; Wisner et al., 1977). The erosion of these resilience mechanisms has resulted in some hazards more likely to result in disasters (Adger et al., 2005; Olive-Smith, 1998). The same modern development that dissolved these traditional social systems introduced new strains on the natural environment (Clark & York, 2005; Marx, 1996). In addition to anthropogenic climate, other features of development, such as population growth, migration to marginal areas, mining, deforestation, monocropping and other practices, have all resulted in increased occurrences of hazards events (Wisner et al., 1994).

Resilience in the face of disaster events is now defined by the capability to absorbe sharp income shocks while participating in globally integrated, liberalized markets (Vanhaute, 2010). Developmental processes in rural areas of the Global South

have brought increased diversification of income sources. More opportunities now exist for allocation of wealth, assets and labor across economic sectors allowing for households to pursue livelihood strategies that diffuse risk. However, the diversified, lucrative and consistent income profiles are those of households in relatively high socioeconomic positions. These segments possess an unprecedented capability for resilience. Wealthy households can strategically develop an income portfolio to mitigate against potential environmental hazards, along with vagaries of economic markets. Given a natural disaster event, they can compensate for the loss of specific income sources—whether due to damage to land, crops, equipment or infrastructure—by focusing on productive activity in those least affected areas. They may even use capital to invest in activity in new areas.

The poor, in contrast, lack this adaptive capacity. Following calamitous events, if their livelihoods lie in an economic sector affected by a disaster, they do not possess a range of income sources in alternative sectors. Such is often the case for agricultural wage workers when large scale agricultural firms lay off workers following a disaster event (Wisner et al., 2004). A similar problem occurs if they experience loss or damage to their few productive assets. They are at risk of falling subject to "poverty traps," circumstances in which coping involves consuming all savings or drawing limited, costly credit, and instead of recovery, a downward spiral of indebtedness and persistent inability to meet basic needs occurs. (Carter & Barrett, 2006; Carter et al., 2007; Jakobsen, 2012; Van den Berg & Burger, 2008).

A distinctive feature of modern developmental processes is change to the livelihood profiles of rural populations of the Global South under neoliberal markets.

Communities once characterized by households provisioning for their basic needs through household level agricultural production, whether on land self-owned or sharecropped, now engage in other forms of economic activity. Agricultural wage production, along with manufacturing and service sector work, whether self-employed or for wage, has proliferated. However, these income sources have been distributed unevenly, with important implications for hazards resilience.

CHAPTER III

LIVELIHOODS AND DISASTER RESILIENCE

Introduction

A correlation between poverty and individual vulnerability and resilience is well known and has been recurrently observed across a variety of contexts, including developed and developing countries, rural and urban areas (Bankoff et al., 2008; Fothergill & Peek, 2004; Kim, 2012). A number of mechanisms underlying this correlation have been uncovered. For one, the poor often experience heightened exposure to hazards due to their limited ability to make proactive life choices to reduce susceptibility to hazards; a limitation due to economic and social constraints placed on land and housing options (Twigg & Bhatt, 1998; Wisner et al., 1998). Second, given that an individual or household experiences an exogenous shock, resilience to the shock and ability to return to a viable existence depends on savings, stockpiles, insurance or credit, which the poor, by definition, have a minimal amount of. Without capital, houses and businesses cannot be rebuilt, farmland cannot be rehabilitated, and medical bills and funeral costs not able to be borne (Albala-Bertrand, 1993; Carter et al., 2007; Kim, 2012). In lieu of savings and stockpiles, credit remains the only other option. Yet, formal sources of credit are often not extended to the poor areas of the world (Stark, 1991) and when they are, it is often restricted for the use of productive inputs and available only to the "creditworthy," that is the relatively wealthy possessing land and assets (Kahn, 2005).

Although the mechanisms underlying poverty outlined above indeed contribute to the poor's vulnerability to natural hazards, it has been found that poverty and vulnerability's correlation does not amount to equivalence (Bankoff et al., 2008; Cardona, 2008). Yet, understanding of variable mechanisms by which poverty does or does not influence resilience and vulnerability is limited (Cardona, 2008; Fothergill & Peek, 2004). In this section I argue that although livelihoods are heavily influenced themselves by capital access, livelihoods themselves exert an influence on hazards vulnerability that is independent from poverty and income.

Resiliency has been an implicit element in the sustainable livelihoods framework from the frameworks inception. Chambers and Conway wrote, "A livelihood is socially sustainable which can cope with and recover from stress and shocks" (Chambers & Conway, 1991, p. 1). Likewise, pioneering work in the hazards vulnerability perspective acknowledge livelihoods as a central determinant of vulnerability, as exemplified by Ben Wisner and colleagues' defining statement that vulnerability involves "the degree to which someone's life and livelihood is put at risk" (1994, p. 9). In some perspectives hazards vulnerability is a function of likelihood of a livelihood being impacted by a hazard alone (Adger, 1999). Yet examination of how livelihoods and household livelihood portfolios governs capability for resilience in the face of natural hazards is only recently being empirically examined in-depth (Speranza et al., 2014), and comparative analysis of recovery by livelihood is altogether absent (Van Den Berg, 2010). Hazards scholarship engaging the livelihoods perspective thus far has been limited to exploration of the impacts of disasters on specific livelihoods and/or sectors (Bankoff, 2008; Barenstein & Leeman, 2013; Van den Berg, 2010; Wisner et al., 1994).

The empirical analysis that follows examines differentials in disaster recovery outcomes by household livelihood portfolios utilizing household level data available for Nicaragua, preceding and following the occurrence of Hurricane Mitch.

Data and Method

This study utilizes four rounds of Nicaragua's LSMS implemented by the INEC and supported by the World Bank. The first round of the survey was conducted in 1998, prior to the Hurricane's occurrence in November of that year. Following the hurricane event, in May and June 1999, officials at INEC visited a sample of households that were covered by the 1998 round and located in communities impacted by the hurricane in order to collect information on the impacts of the hurricane event. According to official INEC documents, extensive effort was made to locate all households from the affected areas that were included in the 1998 round (Steele, 2001). Five hundred ninety-five households were surveyed in the 1999 round, 429 of which resided in rural communities. While all of these households were in communities affected by Hurricane Mitch, not all households experienced direct damage to assets as a result of the hurricane. Two hundred fifteen households experienced damage to their home as a result of the hurricane, 254 did not experience damage to their home, and 126 households were nonreporting. Households not reporting on whether damage occurred to their dwelling were dropped from the panel set, as the focus of analysis is variation between damaged and nondamaged households[1]. Three additional waves following this panel were conducted in 2001, 2005 and 2009, allowing for examination of household welfare over a 10 year period, encompassing the time of the hurricane event. Attrition of the households surveyed in 1999 into the 2001, 2005, and 2009 waves was 19 households. After cases in

which data are not available for all waves and cases in which information on dwelling damage are not provided were removed, the panel consists of 450 households.

This analysis examines the bearing that livelihood profiles have on disaster recovery outcomes through a method informed by theory, while avoiding the arbitrary assignment of households to essentialist categories. Specifically, I use hierarchical agglomerative clustering to identify existing patterns in the livelihoods profiles of households belonging to this population (Fonseca, 2013; Vanneman, 1977). Previous works generating livelihood profiles through clustering methods have varied substantially in their employed measurements of similarity. Some have limited the basis of clustering to variation in usage of agricultural land (Lambin, 2003), while others have distinguished the forms that productive labor have taken. Jansen et al. (2006) and Brown et al. (2006), for example, distinguish household labor by economic sector according to the following categorization: agricultural, nonagricultural, on farm and off farm. Sahn and Stifel (2003) and Van Den Berg (2010) also distinguish agricultural, nonagricultural, farm and off farm forms of labor, but in addition, provide differentiation by ownership of productive means (wage versus owned). In addition to land use and labor measures, others have included levels of wealth, income and consumption as measurements of similarity (e.g., Douarin et al., 2012; Pryer et al., 2002).

As this empirical analysis models resilience as change in household assets, incorporating wealth and income variables in explanatory livelihood variables is inappropriate because it introduces endogeneity and risks conflating resilience as determined by livelihoods with resilience as determined by poverty. Instead, measurements of similarity chosen for clustering are households' proportions of labor in

specific sectors, differentiated by ownership of productive means. Though previous works have focused on the distinction between on farm and off farm labor, substantial variation exists in access to livelihoods within the broad nonfarm economic sector category, a grouping that encompasses such areas as manufacturing, trading, agroprocessing, commercial and service occupations (Barrett et al., 2001; Haggbalde et al., 2010; Reardon et al., 2001). For this reason, this study differentiates within the nonfarm productive labor category, as whether manufacturing, service sector commerce or service sector noncommerce (Deininger & Olinto, 2001; Reardon et al., 2009). I designate household labor in these sectors based on self-reports of specific occupations. Within this population, the occupations of those working in the service commerce sector consist mostly of small business owners; in the service noncommerce sector, salaried professionals, most often employed by the government, predominate. In addition to sectoral designation, additional differentiation is made by ownership of productive means, measured as self-employed, for wage, or in the case of agriculture, sharecropped. Three additional livelihood strategies found in past research to be unevenly accessed by households are designated in this analysis: internal migrant agricultural labor, internal nonagricultural labor and international migrant labor. The specific clustering method utilized is the K means method and the Calinski rule is employed to determine the optimum number of clusters (Calinski & Harabasz, 1975).

The cluster analysis yielded seven livelihood clusters, displayed by proportion of labor in the sectors and livelihoods in Table 3.1. The distribution of household labor within the produced clusters reflect the reality of household livelihood diversification; no cluster features labor exclusively in one sector or livelihood, instead all feature labor in

multiple areas. Nevertheless, most clusters feature predominant livelihoods; six of the seven clusters are characterized by households within the cluster contributing, on average, over 75% of labor to one particular defining sector. These clusters (1-6) are, respectively, characterized by: agricultural production on owned land; agricultural production on sharecropped land; agricultural employment for wage; manufacturing employment for wage; service sector professionals for salary or wage; and entrepreneurs owning their own enterprises. The remaining, Cluster 7, consists of highly diversified livelihood portfolios. Owned businesses in the noncommerce service sector or working for wage in the commerce service sectors are common in this diversified cluster, and almost all households receiving part of all of their income from migrants fell within this clusters.

The residences of households belonging to the three clusters in the agricultural sector, predictably, lie predominantly in rural areas. Ninety one of 92 agricultural own producers, 66 of 67 sharecroppers and 67 of the 75 agricultural wage workers reside in rural areas. Residence of households participating in the other livelihood strategies distribute relatively evenly across rural and urban areas, with 50-57% of households belonging in the highly diversified, manufacturing wage, entrepreneur, or service sector professionals clusters residing in rural areas.

The dependent variable employed in regression models consists of a household wealth index. Principal components analysis, popularized in the social sciences by Filmer and Pritchett (2000), is used to derive the wealth index. The index is derived from measures of ownership of household durables and dwelling characteristics along with the proportions of owned land allocated to annual crop production, perennial crop production

and livestock production. Durables owned are measured as counts indicating the number of each durable a household possessed, while each dwelling characteristic is a binary variable. The dwelling binary variables consist of: quality of wall, quality of flooring, quality of roof, having access to piped drinking water, possessing a flush toilet, possessing no toilet, having electric lighting, and using firewood for cooking. All waves were pooled when deriving the index in order that applied weights be uniformly applicable across time periods and appropriate for longitudinal analysis. The eigenvector obtained for each asset and characteristic are displayed in Table 3.2.

This study offers several theoretical and methodological innovations over previous works utilizing the Nicaragua LSMS and analyzing the impacts of Hurricane Mitch (Jakobsen, 2012; Premand & Vakis, 2010; Van den Berg, 2010). As outlined above, the study is uniquely comparative of resilience and recovery outcomes by livelihood portfolios unevenly distributed according to access to land, assets, and human and social capitals. Second, previous works examining welfare and recovery of those affected by Mitch designate as disaster-affected all those households residing in communities in which some damage occurred, and compare the trajectories of these households with those living in other nonaffected communities (Jakobsen, 2012; Premand & Vakis, 2010). This study in contrast, designates "damaged households"—those households reporting having experiencing damage to their dwelling and assets—as a direct result of the event. I do so for the purpose of engaging the resilience framework, as this designation represents direct losses experienced from the event that must be recouped to return to a predisaster state. Finally, this study employs the recently released 2009 data wave allowing for assessment of long-term recovery over a 10 year period.

Table 3.3 provides descriptive statistics of predisaster median asset scores[2] and median consumption aggregates[3] of households belonging to the identified livelihood clusters. Households belonging to the cluster characterized by agricultural production on owned land had the lowest asset scores, followed in ascending order by households belonging to the sharecropping cluster, the agricultural wage cluster, the highly diversified cluster, the manufacturing wage cluster, the service sector, professionals cluster, and finally, the entrepreneur, owned business cluster. Rankings of livelihood clusters by predisaster consumption aggregates closely parallel wealth index scores. The only difference in relative ranking observed is that households predominated by manufacturing wage labor demonstrate a higher level of consumption than households predominated by service sector professional livelihoods.

Table 3.4 presents descriptive statistics on long-term change in asset index scores, measured as household asset index score in 2009 minus asset index score in 1998, stratified by livelihood cluster and damage to dwelling. Long-term improvement in condition is apparent in these results. All livelihood clusters, those who experienced damage, and those who did not, all demonstrate an improvement in condition over this period.

I first assess short-term losses due to the Hurricane event, by estimating an ordinary least squares regression model with the dependent variable a score of change in household wealth over the 6 months between the 1998 and 1999 survey waves. Livelihood clusters are employed as predictive variables, designated by six binary variables coded according to an effects coding scheme in which the contrasts of each variable sum to zero, with the business owner cluster designated as reference category.

Utilizing effects coding over dummy variable coding offers the benefit of providing estimates in relation to a mean livelihood effect, as opposed to comparison versus a reference category (Alkharusi, 2012). A binary variable representing damage to one's dwelling is included as an explanatory variable, along with interaction effects of the damage variable with each of the seven livelihood binary variables. The interaction variables serve to assess for relative vulnerability by livelihood category, as they examine whether livelihoods were associated with different degrees of loss for damaged households. Effects coding of livelihoods, damage, and their interactions allows for estimation of a main effect of damage in addition to interaction effects. Model 1 includes both rural and urban households (n=450), while Model 2 is restricted to only rural households (n=336) to assess for patterns in vulnerability amongst rural populations in particular. Robust standard errors are employed. Results are displayed in Table 3.5.

Examining the results of Models 1 and 2, the intercept term is found to carry a positive coefficient, indicating that the general trend was an increase in household welfare over this 6 month period. Examining livelihood effects in Models 1 and 2, sharecroppers are the only livelihood demonstrating a statistically significant main effect for each livelihood grouping, with the coefficients carrying negative values. These results suggest that over the period from 1998 to 1999 the welfare of sharecroppers decreased relative to the welfare of other livelihood groupings. Statistical significance is not observable in the main effect of the damage binary variable, indicating that damage independent of livelihoods is not associated with a marked change in household welfare.

Wald tests indicate the addition of the interaction variables adds explanatory power to these models[4]. Model 1 finds the interactions of the agricultural wage and

agricultural own production binary variables with the damage binary variables to be statistically significant, and both of these interactions have negative values, indicating households reliant upon these livelihoods experienced a mean decrease in welfare relative to their nondamaged counterparts. Model 2 finds the significant results of the interaction with the agricultural wage and agricultural own production variables to remain stable when the population is reduced to only rural households. In addition, Model 2 finds the interaction of the highly diversified livelihood with the damage variable to be statistically significant with a negative coefficient, indicating damaged households within this group also experienced a mean decline in condition relative to their nondamaged counterparts within the rural population.

To examine long-term resilience across livelihood groupings, I estimate longitudinal random effects regression models using data from the 1999, 2001, 2005 and 2009 time points, with the dependent variable a change score of household wealth since the predisaster time point. A change score, as opposed to wealth index, is utilized as it better represents resilience, a concept that implies change in relation to an earlier state. The score is calculated for each time point as household wealth index at t, minus household wealth index score at 1998. The change score of wealth captures asset losses due to damage from the event and the gain/loss of wealth and assets occurring with time as a result of buying, selling or receiving assets in the years following the event. Simple coding binary variables representing livelihood clusters and damage, along with interactions of damage on the livelihood binary variables are all employed as explanatory variables. The interactions of damage and livelihood variables were examined for differentials in resilience across livelihood groupings. A random effects model was

determined appropriate for several reasons. As panel data are available for four postdisaster time points, a longitudinal model allows for exploiting variation observable across multiple waves. Also, as opposed to fixed effects longitudinal models that analyze variation only occurring within cases, random effects models allow us to examine variation as predicted by time invariant variables that vary across cases. The central foci of analysis in this study, livelihoods, are as such, generally time invariant (Van den Berg, 2010). Period specific time point variables were included, with 1999 serving as reference category and robust standard errors being employed (Allison, 1999). Model 1 includes both rural and urban households (n=450) and Model 2 is restricted to only rural households (n=336). Table 3.6 presents the results.

Results of longitudinal regression of change in assets over the 1999, 2001, 2005 and 2009 time points are consistent with descriptive results in Table 3.4 in finding time to be associated with an increase in assets across households. Each of the time point variables are significant and positive, as is the intercept term. Furthermore, results suggest that improvement did not only occur over a specific time frame within the years 1999 and 2009, as each period specific time point variable in Models 1 and 2 is found to be statistically significant and have a positive coefficient.

In Model 1, incorporating rural and urban households, the only livelihood main effect found to have significance is the service sector, professionals livelihood binary variable. The coefficient for this variable carries a negative value indicating a mean decrease in welfare for households reliant upon this livelihood, relative to all livelihoods. Significance in this variable falls out in Model 2, likely due to a decreased number of cases of households reliant on this livelihood, as this livelihood was less prevalent in the

rural only population.

The damage variable in both Models 1 and 2 is found to have statistical significance, and the direction of the coefficient is unexpectedly found to be positive. This finding indicates a mean increase in condition of damaged households relative to nondamaged households. Model 1 finds the interaction of agricultural wage workers and damage to be robustly statistically significant, with the coefficient having a negative value. Robust statistical significance and a negative coefficient value in this livelihood group is observed in the rural only population, in Model 2. Furthermore, the negative coefficient of this variable greatly exceeds the main effect of damage in both models, indicating that the welfare of households reliant upon this livelihood decreased substantially, in comparison with their nondamaged counterparts.

Discussion

Results of OLS regression of change in assets over the relatively short, 6 month period spanning the Hurricane Mitch event find damage impacts amongst households reliant upon specific livelihoods, as represented in significant interaction effects of certain livelihood variables and damage. Differences in asset change for damaged households versus nondamaged households are observable amongst those in the following livelihood categories: agricultural wage, agricultural own producers, and the highly diversified. By the time the 1999 survey wave was administered, several months had passed since Mitch struck, and results of this regression suggest that households reliant upon specific livelihoods—manufacturing wage, entrepreneurs and professionals in the service sector—and who reported damage to their dwelling from the event, either experienced minimal actual damage, or they were able to recoup the substantive losses

they experienced from the event; no discernable differences in change in measures of dwelling quality and asset ownership over their nondamaged counterparts are observed for these groups.

Analysis of long-term change in welfare reveal a positive narrative of household and community long-term recovery following the Hurricane Mitch event. Past scholarship finds the 2000s period to be one of economic growth and poverty reduction for Nicaragua (Perez et al., 2012), and results here find this trend encompassed the communities and households impacted by Hurricane Mitch. Results of this study find that over the period from 1998 to 2009, an increase in household welfare, as represented by the constructed wealth index is observable amongst damaged and nondamaged households across all levels of stratifications, whether by predisaster consumption or by livelihood portfolio.

Improvement in condition across households notwithstanding, substantial differences in the long-term improvement of damaged households is observable by livelihood cluster. The experience of sustaining damage to one's dwelling from the Hurricane event—as represented in the damage main effect—is found to be associated with an improvement in household welfare above that of nondamaged households for households reliant upon six of the seven livelihood forms delineated in this analysis. For the remaining group—households reliant upon agricultural wage production—a reduction in condition relative to their nondamaged counter parts is observed, as they did not obtain the gains over the 11 year period made by nondamaged households reliant on the same livelihoods.

Hurricane Mitch ravaged the agricultural sector in Nicaragua, destroying more

than 1/3 of all agricultural crops (Muller, 2013). The relatively low welfare gains of agricultural wage workers reflect that the double blow of destruction to their home assets, and a shock to the entire economic sector in which their livelihoods are derived had an enduring impact on these households. In contrast with damaged agricultural own producers who also demonstrated short-term losses, agricultural wage households continue to demonstrate losses 11 years after the event. Although predisaster measures of wealth and consumption (Table 3.1) indicate agricultural wage households to be in a higher economic position than sharecropping and agricultural own producers, in terms of resilience, agricultural wage households performed poorer than these and all other livelihood groupings. This livelihood category lies in a sector that is by essence, sensitive to the vagaries of the natural environment; furthermore, this particular livelihood form features dependence on employers and landholders. With the agricultural sector having sustained heavy damage, employers and landholders may have adapted use of their investment capitals and land in such a way that rendered agricultural wage workers under or unemployed, and the group's lack of productive means left them without adaptive capacity at a time in which they had an exigent need for income to recoup damages.

Conclusion

Developmental processes under neoliberal markets have brought an increase in the livelihood forms that exist in rural areas of the Global South. Household production on self-owned or sharecropped land has been increasingly replaced by wage employment in the agricultural sector, along with self-employed and wage employment in the manufacturing and service sectors. Opportunities now exist for allocation of wealth,

assets and labor across economic sectors allowing for households to pursue livelihood strategies that diffuse risk through participation in nonfarm livelihoods. However, access to these income sources is unequal, due to the role played by capital, education, skills, networks and networks in accessing these livelihoods.

Given shocks of any kind—economic or environmental—those lacking capitals and capabilities and solely reliant on wage employment are poised in a tenuous position at risk of falling subject to "poverty traps" (Carter & Barrett, 2006; Carter et al., 2007; Jakobsen, 2012; Van den Berg & Burger, 2008). They lack a range of income sources diffusing risk from sector specific shocks, and furthermore, they lack capital that could be invested flexibly as an adaptation response. This analysis finds reliance on wage employment in the context of natural disasters is especially problematic for those whose livelihoods lie in the agricultural sector, which is intrinsically sensitive to environmental disruptions. Whether relative lack of resilience for this group only exists in cases in which disasters negatively impact the agricultural sector, is a question for future research. The findings of this study, and the implications for theory building in the disasters field that they suggest, beg further comparative research on livelihoods and resilience in other disaster contexts.

Endnotes

1. Sensitivity analyses by livelihood profile and asset recovery outcome find no selection bias in the dropped, nonreporting cases.

2. No difference was found in the relative rankings of the clusters when the mean was used to derive each cluster's asset index score.

3. The consumption aggregate is based on expenditures for food and nonfood items and is measured per capita to account for variation in household size. The consumption aggregate accounts for price variation across geographic regions by adjusting household consumption according to a price quotation calculated at the level of each municipality.

4. For Model 1: $Prob > F = 0.03961$; For Model 2: $Prob > F = 0.0517$.

Table 3.1: Livelihood Clusters by Mean Proportion of Household Labor in Specified Livelihood Sectors

Proportion of Household Labor in:	Agricultural Own Producers	Sharecroppers	Agricultural Wage	Manufacturing Wage	Service Sector Professionals	Business Owners	Highly Diversified
Agricultural owned	0.90	0.00	0.07	0.01	0.01	0.02	0.02
Agricultural wage	0.04	0.16	0.82	0.02	0.02	0.02	0.02
Manufacturing owned	0.01	0.00	0.01	0.03	0.01	0.02	0.20
Sharecroppers	0.00	0.92	0.00	0.00	0.01	0.01	0.02
Manufacturing wage	0.01	0.01	0.01	0.78	0.03	0.03	0.03
Service sector, commerce, owned	0.01	0.01	0.02	0.02	0.02	0.77	0.03
Service sector, commerce, wage	0.00	0.00	0.00	0.01	0.02	0.02	0.22
Service sector, noncommerce, owned	0.01	0.01	0.01	0.02	0.02	0.04	0.22
Service sector, noncommerce wage	0.02	0.03	0.04	0.10	0.86	0.08	0.08
Domestic migrants, agriculture	0.01	0.01	0.00	0.00	0.00	0.00	0.03
Domestic migrants, nonagriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.07
International migrants	0.00	0.00	0.00	0.00	0.00	0.00	0.04
N =	92	71	75	32	82	44	54
N (rural) =	91	66	67	16	43	22	31

Table 3.2: Asset Index: Eigenvectors Derived from Principal Components Analysis, Pooling Time Points (1998, 1999, 2001, 2005, 2009)

Variable	Eigenvector
Radio	-0.114
Television	0.0632
Refrigerator	0.2223
Stove	0.2856
Iron	0.1816
Grinding machine	-0.2109
Fan	0.2665
Mixer	0.2585
Toaster	0.1354
Oven	0.0596
Sewing machine	0.1271
Car	0.1028
Boat	-0.0484
Bike	0.1101
Motorcycle	0.0596
Wall, high-quality	0.2504
Floor, high-quality	0.2618
Roof, high-quality	0.0976
Piped drinking water	0.3112
Surface drinking water	-0.1929
Flush toilet	0.2511
No toilet	-0.1866
Electric lighting	0.3174
Firewood to cook	-0.3109

Table 3.3: Median Predisaster (1998) Asset Index Score and Median Consumption Levels of Livelihood Clusters, Ranked by Asset Index Score

Livelihood Cluster	Wealth Index Score	Consumption
Agricultural production, on owned land	-0.4586	2,923
Agricultural production on sharecropped land	-0.3452	3,029
Agricultural wage labor	-0.1931	3,048
Highly diversified income portfolios	0.2513	3,572
Manufacturing wage labor	0.3635	4,219
Service sector work, salaried professionals	0.5653	4,065
Service sector work, owned business	0.7749	4,998

Table 3.4: Median Change in Household Asset Index, by Livelihood Cluster and Experience of Damage to Dwelling

Livelihood Cluster	Damaged HH		Nondamaged HH	
	2009-1998	n	2009-1998	n
Agricultural producers, owned land	1.7347	40	1.4797	52
Sharecroppers	1.5752	28	1.8297	43
Agricultural wage workers	1.1511	39	1.5206	36
Highly diversified	1.4216	29	1.0181	25
Manufacturing wage workers	0.6152	12	0.8955	20
Service sector professionals	0.9542	36	0.8261	46
Business owners	0.715	20	0.1914	24

Table 3.5: Ordinary Least Squares Regression of Household Wealth Change Score, 1999-1998

	Model 1		Model 2	
	Coefficient	P>|t|	Coefficient	P>|t|
Highly diversified	-0.0570	0.243	-0.0864	0.183
Manufacturing wage	0.0685	0.415	0.1222	0.320
Agricultural wage	0.0188	0.596	-0.0381	0.359
Sharecroppers	-0.0880*	0.017	-0.1014*	0.021
Agricultural own producers	-0.0179	0.585	-0.0530	0.178
Service sector professionals	-0.0117	0.791	0.0472	0.421
Damage	0.0357	0.095	0.0380	0.210
Highly diversified * damage	-0.0476	0.330	-0.1292*	0.047
Manufacturing wage * damage	0.1197	0.155	0.1630	0.184
Agricultural wage * damage	-0.0913*	0.010	-0.0843*	0.043
Sharecroppers * damage	-0.0490	0.182	-0.0378	0.388
Agricultural own producers * damage	-0.0740*	0.024	-0.0806*	0.041
Service sector professionals * damage	0.0249	0.574	0.0907	0.122
Intercept	0.0968***	0.000	0.1277***	0.000
R-squared	0.0573		0.0879	

Note: *p<.05; **p<.01; ***p<.001

Table 3.6: Random Effects Regression of Household Wealth Change Score, (*t*=1999, 2001, 2005, 2009)

	Model 1		Model 2	
	Coefficient	P>t	Coefficient	P>t
Highly diversified	-0.0660	0.230	-0.0488	0.458
Manufacturing wage	0.0418	0.605	0.1431	0.198
Agricultural wage	0.0493	0.239	-0.0110	0.814
Sharecroppers	0.0409	0.355	0.0156	0.743
Agricultural own producers	0.0341	0.391	-0.0369	0.389
Service sector professionals	-0.1189*	0.013	-0.0953	0.165
Year 2001	0.1474***	0.000	0.1353***	0.000
Year 2005	0.2578***	0.000	0.2206***	0.000
Year 2009	0.8840***	0.000	1.1105***	0.000
Damaged	0.0548*	0.014	0.0580*	0.045
Highly diversified * damage	-0.0081	0.882	-0.0293	0.656
Manufacturing wage * damage	0.1060	0.190	0.1265	0.255
Agricultural wage * damage	-0.1181**	0.005	-0.1270**	0.007
Sharecropper * damage	-0.0306	0.488	-0.0054	0.910
Agricultural own producers * damage	-0.0454	0.254	-0.0523	0.222
Service sector professionals * damage	0.0071	0.882	-0.0705	0.305
Intercept	0.0921***	0.000	0.1161***	0.000
R-squared within	0.3124		0.4837	
R-squared between	0.0972		0.1046	
R-squared overall	0.2315		0.3640	

Note: *p<.05; **p<.01; ***p<.001

CHAPTER IV

HOUSEHOLD MIGRATION AS A LIVELIHOOD RESPONSE TO A NATURAL DISASTER: NICARAGUA AND HURRICANE MITCH

Introduction

In recent decades, widely varying speculations of the numbers of peoples to be forced to migrate in future years, as a result of unchecked anthropogenic climate change, have been circulated in the media and policy-making community (Faist & Schade, 2013; Gemenne, 2011). The term "environmental refugees" (IPCC, 1990) has been invoked as a descriptor representing the peoples to be passively displaced by novel environmental pressures introduced by climate change. Within much of the scholarly community, however, "alarmist" speculations have been met with skepticism, and heavy criticism has been made of the assumptions of the workings of the natural environment-population relationship on which much projection has been based.

A first prominent criticism is that "neo-malthusian" conceptualizations of environmentally forced migrations are unicausal and overly environmentally determined (Gemenne, 2011; Piguet,2013). Framing the environment as an exogenous, uniform pressure fails to account for the observed fact that the environment is a variable factor that dynamically interacts with a host of other social and institutional factors such as household and community migration history, gender and socioeconomic characteristics,

and broader economic and political factors (Cannon, 1994; Castles, 2002; Renaud et al., 2011; Tacoli, 2009; Wisner et al., 1994). A second criticism is that the environmental refugee concept implies a single environmental migration form as a result of climate change, as opposed to acknowledging a wide range of environmentally influenced migration forms. Predominant differentiating features of environmental migrations that research has identified are the degree of agency that individuals and households possess in the face of environmental pressures (Adamo, 2009; Hugo, 1996; Renaud et al., 2007; Renaud et al., 2011) and the chief motivation behind movements, such as migrating in pursuit of an alternative income, or moving due to the loss of a home dwelling (Afifi, 2011). Finally, debate exists as to whether climate change influenced movements are reactive consequences of vulnerability and a failure to adapt otherwise as "alarmist" accounts suggest, or are instead proactive movements representative of resilience and capability of adaptation and innovation (Black et al., 2013; Faist & Schade, 2013; McLeman, 2010; Piguet, 2010). Indeed, the empirical evidence thus far finds the bulk of environmentally influenced migrations to be voluntary and internal within the boundaries of a country (Adamo & Izazola, 2010; Gemenne, 2011). This insight implies a contrasting forecast from that of alarmists' claims of throngs of environmental refugees imposing on foreign countries. Instead, the result of climate change may be households remaining in communities, but increasingly utilizing the migration of select members as a household income diversification strategy to buffer climate change's detrimental effects (Banerjee et al., 2010; Tacoli, 2009).

The International Organization for Migration (IOM) has put forth a definition of environmentally influenced migrations robust to the central criticisms leveled against

reductionist, neo-Malthusian conceptualizations of environmental migrations. IOM's definition conceptualizes the environment as a migration push factor (Lee, 1966; Petersen, 1958; Zelinsky, 1971), while accounting for a wide range of environmentally influenced migrations with differentiating features. The IOM definition states:

> Environmental migrants are persons or groups of persons who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad (IOM, 2007, p. 1-2).

Though within the body of research acknowledgement has been made of an array of environmentally influenced movements operating according to differing logics, empirical study explicating specific movements to develop understanding of the populations and population segments likely to move under certain conditions is limited (Banerjee et al., 2011; Faist & Schade, 2013; Gray & Mueller, 2012; McLeman & Hunter, 2010; Wrathall, 2012). Renaud et al. articulate the urgency of the research agenda: "The discussion about which people are migrating, where, for what environmental reasons, and in need of what kind of assistance must be driven forward at an accelerated pace" (2011, p. e29). Though explicating the motivation behind migrations is notoriously difficult and often at best speculative (Faist & Schade, 2013; Wrathall 2012), analysis of specific types of movements variably reactive to a range of environmental hazard events holds promise for advancing this area (Banerjee et al., 2011; Faist & Schade, 2013; Wrathal, 2012 McLeman & Hunter, 2010). McLeman and Hunter (2010) outline several variable "general dimensions of environmental migrations" that through empirical investigation have the potential to deepen understanding of environmentally influenced migration processes, the decisions underlying movements

and the relation of movements to vulnerability or capability. These consist of: the temporal dimensions of the environmental pressures and resulting migrations; the spatial dimensions of influenced movements; the causal dimensions by which specific types of environmental events variously stimulate or constrain movement; and the use of migration relative to other possible adaptations and reasons why migration is or is not engaged in by different individuals and groups.

Focusing on the dimensions outlined in McLeman and Hunter's schema, this study empirically examines international migrations of individuals out of Nicaraguan households in response to the devastating Hurricane Mitch event, with migrations relating to household livelihood strategies the central focus of the study.

Literature Review

The temporal and spatial dimensions of hazard influenced migrations are partly a function of specific aspects of the influencing hazard event. Influencing hazard events have been temporally differentiated as to whether rapid or slow in onset, and the Intergovernmental Panel on Climate Change (IPCC) has projected increased occurrence of both to be consequences of anthropogenic global climate change (IPCC, 2007). Distinction between rapid and slow onset hazards is worthy of making in the context of household adaptation strategies in the face of hazards, as the immediacy of rapid onset events is associated with reduced agency of individuals and households (Quarantelli, 1998). In terms of migration, at the very least, households have less choice of when they will engage in migration (Banerjee et al., 2011). In severe cases, rapid onset events compel individuals and households to flee homes and areas before, during, or soon following events (Mcleman & Hunter, 2010). These temporary displacements to refugee

camps or other locations brought on by an unexpected swift event feature the lack of agency and high relationship to vulnerability connoted by the "environmental refugee" designation (Gray et al., 2014; Myers et al., 2008; Renaud et al., 2011).

In addition to the refugee-like permanent, or temporary displacements that rapid onset events may precipitate, a range of other spatially and temporally differentiated movements have been identified as consequences of slow and rapid onset environmental hazards with a single disaster event possibly resulting in multiple forms of displacement (Gray & Mueller, 2012; Gray et al., 2014; Hugo, 1996; Renaud et al., 2007). Differentiated movements include temporary and permanent labour migrations, household migrations (the movement of whole households to another location), and entire community resettlements. Return migration too, is a frequent occurrence (Fussell et al., 2010; Loebach, 2015; Tacoli, 2009). Movements vary spatially from short-range localized movements, to intraregional, interregional, or international migrations (Banerjee et al., 2010; Gray et al., 2013 Renaud et al., 2009; Sherbinin et al., 2008).

One causal pathway by which hazards induce push to migrate is through altering the context within which households pursue livelihood strategies (Bilsborrow, 1992; Hunter, 2005; McLeman, 2010; Renaud et al., 2007; Zelinsky, 1971). For instance, in the case of slowest onset hazards in the form of long-term deterioration of environmental conditions, households often migrate to areas rich in natural capitals when deterioration of natural capitals utilized in livelihoods becomes evident (Afifi, 2011; Bilsborrow, 1992; Massey et al., 2010). The new economics of labor migration (NELM) model outlines a specific form of environmental migration for livelihood purpose operating according to a particular causal logic. According to the NELM model, households residing in rural

underdeveloped areas utilize the select migration of individual members of the household as a livelihood strategy to diversify risk and smooth income in the case of shocks—shocks due both to price fluctuations in integrated markets, and to the vagaries of nature (Julca, 2011; Stark, 1991). There is mounting evidence in support of migration utilized to this end, with studies finding remittances highly reactive to income shocks associated with changes in the natural environment, whether hazards be slow or most rapid in onset (e.g., Dun, 2011; Lucas & Stark, 1991; Massey et al., 2010; Mohapatra et al., 2009; Yang & Choi, 2007;).

Within the context of developing communities, and in those cases in which a hazard impacts households' incomes and capitals by destroying productive assets or land, or disrupting the functioning of the local economy, the pursuit of livelihood migrations is a plausible ex-post household adaptation response. However, this causal process is complicated in that environmental change has the potential to constrain ability to access livelihood migration at the same time that it induces increased motivation to do so (Black et al., 2011; MeLeman, 2010). Migrant movements, and international movements in particular, are costly and require capital to initiate (Massey, 1990; Portes & Rumbaut, 2006). Natural capitals are one form of capital drawn upon to fund movements, in addition to human, financial, physical, and social capital (Chambers & Conway, 1991; Hunter et al., 2013; Scoones, 1998). Also, disasters shocking the agricultural sector impact those lacking natural capitals, but that are reliant upon employment in the agricultural sector as large scale agricultural firms respond to crops and land being destroyed by laying off workers (Wisner et al., 1994). The destruction of household capital and interruption of incomes associated with environmental hazards may cause, for

some, the costs associated with migrations to become insurmountable.

In terms of the adaptation dimensions of hazards events, the NELM model conceives of livelihood migrations as a function of households' capabilities as well as vulnerability. Perceived vulnerability influences the degree to which households may feel compelled to pursue migration (Gemenne, 2011). At the same time, ability to engage in this strategy is a function of household capital within the opportunities and constraints of a given social and institutional context (Bebbington, 1999; Chambers & Conway, 1992; Faist & Schade, 2013; Scoones, 1998).

Empirical studies assessing for ex-post movements following the causal logic of the NELM model have been conducted extensively in the context of drought events (Findley, 1994; Gray & Mueller 2012a; Hunter et al., 2013; Julich, 2011). Droughts are temporally more rapid in onset than gradual environmental deterioration, although slower than catastrophic rapid onset events. They are "creeping phenomenon" (Julich, 2011) characterized by building pressure over a course of months. In comparison with other hazard events, droughts are relatively high in probability, and those exposed to these events are likely to witness more than one in their lifetime (Joseph, 2013). This high probability feature of droughts plays into the degree that droughts are figured into households' calculus of risks. Findley's (1994) study of the influence of drought events on migrations from rural Mali lends credence to the turned-on demand within the context of constrained opportunity influence of environmental shocks, finding drought periods to be associated with a decline in international migrations to France, but an increase in less-costly, short-distance moves to Mali's urban areas. The work of Hunter et al. (2013) examining US bound migration from Mexico in the context of rainfall shocks, finds

droughts' influence on migration to be a nonlinear function of time, and households' capability for adaptation. Droughts decrease short-term migration likelihood, likely because of the detrimental effects of shocks on households' natural capital. In the long-term, however, droughts result in increased US bound emigrations as households pursue this livelihood option once the initial shock subsides. This increase, however, is observable only in those historical migration regions in which there are high levels of migrant social capital that can be drawn upon to overcome the costs of initiating migrations.

Rapid onset events differ substantially from droughts in multiple aspects: their probability of occurrence, the degree of their impacts, and the time between the initiation of the event and the conclusion of its effects (Joseph, 2013). These differentiating features have bearing on household adaptation strategies that encompass the decision to engage in migration. The immediacy of rapid onset events and the degree of their consequences supply conditions under which there is high motivation to adapt livelihood strategies, yet at the same time, the degree of their impact could play heavily into constraining opportunities. Gray et al. (2013) find the Indian Ocean Tsunami as experienced in Indonesia resulted in an increase in several spatially differentiated migration forms: movements within home communities, movements outside of home communities, and movements to displacement locations. Two studies in the respective contexts of flood events in rural Nepal (Banerjee et al., 2011), and a cyclone event in Bangladesh (Mallick, 2014), also find resulting rises in short-distance, internal migrations. Gray and Mueller (2012a; 2012b), however, examining migrations within Bangladesh find no relationship between flood events and internal migrations.

While the existing empirical evidence lends some support for rapid onset events as exerting a stimulating influence on short-distance livelihood migrations, few studies assessing rapid onset hazards influence on costly international migrations have been performed, and the results of existing studies are conflicting. Halliday (2006) finds a severe earthquake in El Salvador resulted in reduced likelihood of international migration to the United States and Canada, while Gray and Mueller (2012) find no relationship between flood events in Bangladesh and long-distance movements.

In terms of the characteristics of migrants in the context of rapid onset hazards, Mallick (2014) finds short-distance migrants to be selected according to low levels of income and capital, and the authors interpret these movements as 'displacements' to urban slum areas, reflective of vulnerability, as opposed to agentic movements, associated with capability and adaptation. Gray et al. (2013) find that while tsunami induced movements to displacement camps are associated with social vulnerability characteristics (female composition, household expenditures), other induced movements do not feature these characteristics, indicating nondisplacement movements to be adaptations of the capable. Finally, in demonstration of the constraining influence of rapid onset hazards, Banerjee et al (2011; 2013) find that those flood affected Nepalese whose agricultural land had been damaged were less likely to migrate for work than households whose agricultural land had not been affected. Furthermore, significant proportions of interviewed households expressed their desire to migrate in order to aid their recovery, but lacked sufficient resources to do so.

Study Aims

Hurricane Mitch exerted a heavy toll on Nicaragua, causing over $1 billion in losses, approximately 51% of the country's 1997 GDP (Guha-Sapir et al., 2004). While the eye of Hurricane Mitch did not make landfall on Nicaragua, the hurricane brought record rains that gave rise to floods, strong currents and landslides, resulting in approximately 3,000 deaths (Steele, 2001), over half a million people rendered homeless, and extensive damage inflicted to infrastructure and land. The impacts of the Hurricane Mitch event were particularly high for those involved in the agricultural sector comprising 28% of Nicaragua's GDP, and employing 36% of the economically productive population (ECLAC, 1999). Within the North Atlantic, North Pacific, and North-Central regions, heavy losses of export crops, including coffee, sesame, sugar cane and peanuts, occurred along with losses of basic sustenance crops including grains, tubulars, bananas and vegetables (ECLAC, 1999).

This study examines the influence of this rapid onset event on migrations, spatially delimited to include only international movements. The movements under study are further limited to those meeting two conditions of the NELM causal model: the households of migrants remain at their place of origin, and migrants take work at places of destination. Within these conditions, this study asks, did the Hurricane Mitch event induce livelihood migrations ex-post? Do patterns of migrant selectivity in Mitch affected communities approximate patterns observable in nonaffected communities? Are selectivity patterns indicative of migration as a last-resort strategy utilized by the socially vulnerable, or instead is migration an adaptation available only to households with a relatively high capability for resilience?

Data and Method

This study utilizes data from the Nicaragua's Living Standards Measurement Study Survey (LSMS) implemented by the National Institute for Statistics and Censuses (INEC) and supported by the World Bank. The central dependent variable representing international migration explicitly for the purpose of work is derived from two questions asked of household heads in the 2001 data waves. The questions read: "Is there someone who lived in this home who currently lives in another country"; and "In the last 12 months did a member leave the municipality temporarily for work purposes" (INEC 1998).

Having lived in an area impacted by Hurricane Mitch is designated at the municipality level, according to INEC's designation in a 1999 household survey of impacted households. Table 4.1 presents the number of international livelihood migrations to country destinations, stratified by year, and if originating from a disaster affected municipality. From the sample of 3,945 households, a total of 453 international livelihood movements occurred over the 1996-2001 period. Two hundred eighty-six of migrations were from households that were impacted by the hurricane, while 167 migrations were from nonaffected households.

This study uses discrete time event history methods to model the hazard of household migration, a method common in modeling migrations, and especially migrations influenced by time variant, contextual factors (Allison 2014; Fussell et al., 2014; Gray and Mueller 2012a; 2012b; Massey and Espinosa 1997; Piguet 2010). Likelihood of occurrence of a household migration is estimated according to a logistic regression model, taking the form displayed in Equation (1). The data are constructed as

household years in order to evaluate livelihoods processes occurring at the household level. Household years begin in 1996 and follow discrete 1 year intervals to the year 2001, in order to include 3 years pre- and post-Mitch event.

$$\log\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_p X_{ip} \qquad \text{Equation [1]}$$

Predictive variables are employed at the household and community levels and are drawn from the 2001 data wave[1]. Household composition variables account for individual characteristics that influence migration likelihood. These consist of age, sex, and number of household members (Massey & Espinosa 1997; Portes & Rumbaut, 2006). Sex of household head is dummy coded with females as reference category.

Following the sustainable livelihoods framework (Bebbington, 1992; Chambers & Conway, 1992; Scoones, 1998), this study considers the influence of possession of human, physical, natural and social capital variables. Capitals are assessed through the use of the following household level indicators: the education level of household heads, ownership of agricultural land, business ownership, migrant social capital (number of previous household migrations), and indexes representing household durables and livestock ownership, respectively. Household durable and livelihood indexes are produced utilizing principal components analysis (Filmer & Pritchett, 2000; Montgomery et al., 2000) and are based on counts of ownership of household items; binary variables representing quality of the household dwelling; and counts of ownership of livestock (Jakobsen, 2012).

Land ownership and engagement in agricultural production have been found to separately exert influence on migration likelihood (Massey, 1990). Land ownership may be a representation of capital that some agriculturally reliant households possess, while

others engaged in less capital intensive agricultural production do not. In addition, migration is at times utilized as a means to upgrade agricultural productivity with the income from migrants invested in the purchase of agricultural land and other productive capitals (Deshingkar, 2012;Massey, 1990). For these reasons, this study additionally considers degree of household engagement in agricultural production, operationalized at the household level as the percentage of economically productive members involved in nonagricultural occupations (Van Wey, 2004).

To examine for possible impacts of Hurricane Mitch on household migrations, a municipality level, time variant, dummy variable is employed. The variable is assigned a value of 1 for the household years of 1999, 2000, and 2001 if the household resides in an affected community. Other municipality level control variables included are a rural status dummy variable (Fussell & Massey, 2004), and a measure of general migrant social capital, equaling the average value of all residing households' number of previous migrations (Massey et al., 1990). The household sampling procedure implies potential clustering of households within municipalities and robust standard errors are employed accordingly.

Interaction effects of the Hurricane Mitch impact variable with the household level predictive variables are introduced in Models 2 and 4 to examine if the characteristics of migrant sending households differ in the context of the Hurricane Mitch event. In addition, an interaction effect of the Hurricane Mitch variable with the municipality level general migrant social capital variable is included, as previous studies have identified a mediating influence of community migration history (Hunter et al., 2013).

Results

Table 4.2 presents results of discrete time logistic regressions predicting the likelihood of livelihood migrations. Models 1 and 2 feature the full population while Model 3 is limited to households residing in rural areas.

Household compositional characteristics exert influence on migration likelihood in models, with variable influence observable in rural and urban contexts. Having a male as household head is positively associated with migration likelihood in Models 1 and 2. Significance in the sex of the household head variable falls out in analysis of the rural population alone (Model 3), while age of the household head becomes significant. These results are consistent with literature demonstrating differential influence of demographic characteristics in varying contexts (Curran et al., 2005; Massey et al., 2006). The number of household members is positively associated with migration likelihood in all models.

Consistent with a large amount of literature on the role played by familial social networks, robust and positive effects of household migrant social capital is observable in all models, as is the influence of general migrant social capital, the combined impacts of migrant networks and other endogenous, self-perpetuating effects of previous migration at the community level (Loebach & Korinek, 2014; Massey et al., 1994). The measure of physical capitals, household durables, is also robustly associated with a positive influence of migration likelihood in all models, while the other forms of capital ownership—agricultural land ownership and livestock ownership—are not found to influence migration likelihood.

The effect of the Hurricane Mitch impact variable is nonsignificant before the inclusion of interaction variables (Model 1). Wald tests find the employment of

interaction effects with the Hurricane Mitch variable in Models 2 and 3 add explanatory power to the models, and certain household capitals and livelihood practices are observable as important determinants of migration likelihood in the context of natural hazard events. The interaction of business ownership and disaster impact in Models 2 and 3, is significant and indicative of reduced migration likelihood for households having these characteristics. The main effect of business ownership is positive in Model 2, indicating business owners in nonimpacted communities have a higher likelihood of migration than nonbusiness owners. The degree of the interaction effect in Model 2, however, indicates reduced likelihood to the extent that business owners who resided in disaster impacted communities have a lower likelihood of migration than nonbusiness owners. In addition, a robust and positive interaction effect with household level migrant social capital is also observable in Models 2 and 3.

Table 4.3 presents event history logistic regressions predicting the likelihood of nonlivelihood migrations. Models find several variables predictive of livelihood migrations also similarly predictive of nonlivelihood migrations. These are: number of household members, municipality level migrant social capital, household level migrant social capital and ownership of household durables. No statistically significant effect of living in hurricane affected communities is observable in Model 1 and no interaction effects are observable as significant in Model 2.

Conclusion

The results of this study find no net stimulating or restricting effect of Hurricane Mitch on international livelihood migration, or international nonlivelihood migrations, originating from Nicaraguan households impacted by the hurricane. Results do indicate,

however, that by influencing the likelihood of households with specific livelihood characteristics in pursuing migration as a livelihood adaptation response, the Mitch event had the effect of altering the composition of international migration streams originating from Nicaragua.

Migrant social capital played an important role in enabling households' ability to pursue migration as an adaptive response to a hazard event, in this case. Consistent with the findings of Hunter et al. (2013) in the context of drought events, amongst hurricane impacted households access to migrant social networks was associated with an increased likelihood of livelihood migration—an increase beyond the selectivity according to access to migrant social networks also observable for nonimpacted households. In addition, positive selectivity according to ownership of physical assets, and living in communities with an established migrant network is equally observable for disaster impacted and nonimpacted households. These results of equal, or increased migrant selectivity, according to access to physical and social capital in the context of the Hurricane Mitch event suggest these livelihood migrations are a reflection of capability to migrate, an adaptation response, as opposed to migration as a demonstration of relative vulnerability.

The significant interaction effect of business ownership demonstrates that those households that owned businesses and experienced damage due to the hurricane featured a reduced likelihood of engaging in livelihood migrations. These results could be interpreted as either symptomatic of this group's capabilities or vulnerability. In the vulnerability interpretation, business owners may be vulnerable to the loss of high levels of physical capital associated with their businesses; destruction to physical capital may

have resulted in impacted business owners becoming constrained from engaging in household migrations. The alternative interpretation is a reduced likelihood of migration for households featuring business ownership may reflect a reduced need for adaptation for these households. Research has found natural disasters often have a stimulating effect on the commercial sector by driving demand for construction, building materials and home/office furnishings (Zhang et al., 2009). The case study performed by Christopolos et al. (2010) on one impacted Nicaraguan municipality finds that some Hurricane Mitch aid efforts were aimed specifically at entrepreneurs, a finding that echoes observations in other contexts of entrepreneurs and small business owners as disproportionately benefitting from aid and relief efforts in disaster contexts (Kampadia, 2015). Potentially, households featuring this livelihood form may have been less deleteriously impacted in comparison with that of households with other livelihoods; for this reason, these households did not experience the same inducement to migrate as others living in disaster affected communities.

Whereas this study finds impacts of Hurricane Mitch on migrant characteristics when examining migrations consistent with the criteria of the NELM theoretical framework, no impact of Hurricane Mitch on the composition of nonlivelihood migrations is observable. Also, contrary to this study's hypothesis, no evidence of influence on engagement in nonagricultural livelihoods on migration likelihood is observable.

In conclusion, this study offers further evidence that the "environmental refugee" concept, is at best, of limited applicability in characterizing rapid onset hazards' impacts on population mobilities. The evidence in this case suggests international livelihood

migrations to be a mechanism of resilience, which for many is inaccessible. This study's results also suggest that characterizing "environmental refugees" as those vulnerable to environmental hazards risks detracting attention away from the unfortunate circumstances of those incapable of the migration adaptation; the vulnerable left behind and highly susceptible to "poverty traps" (Carter & Barrett, 2006; Carter et al., 2007)—downward spirals of poverty and persistent inability to meet basic needs caused by a lack of access to the capitals necessary for adaptation in the face of severe household shocks.

Endnotes

1. Drawing predictive variables from 2001 implies not accounting for temporal variation in predictors, an acknowledged study limitation.

2. When the data were limited to 1999 results were substantively similar.

Table 4.1: Destinations of International Livelihood Migrations by Year, if Originated from Disaster Affected Municipality

Country	1996	1997	1998	1999	2000	2001
Migrations originating from hurricane affected municipalities						
United States of America	7	4	5	11	9	8
Canada	-	1	-	4	-	-
Greece	-	-	-	-	-	-
China	-	-	-	1	-	-
Costa Rica	15	11	44	45	47	73
El Salvador	1	-	-	-	-	2
Honduras	1	-	-	-	-	2
Guatemala	1	1	4	1	1	-
Mexico	-	1	-	1	-	-
Belize	-	-	-	-	-	2
Panama	-	-	1	-	-	-
Unknown	-	-	-	1	-	-
Total, damaged households	25	18	54	64	57	87
Migrations originating from nonaffected municipalities						
United States of America	2	1	4	7	11	2
Canada	-	1	-	-	1	-
Greece	1	-	-	-	-	2
Costa Rica	15	12	15	18	23	30
Honduras	-	-	-	4	6	1
El Salvador	-	1	3	-	1	-
Guatemala	-	-	-	-	1	2
Belize	-	-	-	-	-	-
Panama	-	1	-	-	-	-
Total, nondamaged households	18	16	22	29	43	36
Total, all households	43	34	76	94	100	123

Table 4.2: Discrete Time Logit Predicting the Likelihood of Livelihood Migration from a Household

	Model 1		Model 2		Model 3	
	Hazard Ratio	p>|z|	Hazard Ratio	p>|z|	Hazard Ratio	p>|z|
Household characteristics						
HH head is male	0.63**	0.001	0.62**	0.001	0.73	0.259
HH head age	1.00	0.213	1.00	0.274	1.01*	0.014
HH head education	0.93	0.434	0.94	0.437	1.04	0.750
Total hh members	1.09***	0.000	1.09***	0.000	1.09***	0.000
HH gender composition (female %)	1.29	0.380	1.33	0.317	2.03	0.150
Durable assets	1.08*	0.010	1.11**	0.003	1.17*	0.013
Ownership of agricultural land	1.14	0.454	1.24	0.291	1.05	0.854
Livestock, index	1.01	0.829	1.04	0.416	0.89	0.418
Members engaged in nonagricultural occupations (%)	0.98	0.949	0.82	0.414	1.16	0.663
Ownership of business	1.22	0.131	1.46*	0.013	1.47	0.187
Migrant social capital (total hh migrations prior to 1996)	2.16***	0.000	2.11***	0.000	2.10***	0.000
Municipality characteristics						
Disaster affected	1.24	0.123	1.26	0.502	0.93	0.905
Migrant social capital (avg migrations per hh)	8.44***	0.000	8.36***	0.000	57.09***	0.000
Rural	1.01	0.931	0.96	0.851	-	-
Interaction effects with disaster affected						
Interaction, hh migrant social capital	-	-	1.41**	0.006	1.71**	0.002
Interaction, hh durable assets			0.89	0.083	0.87	0.376
Interaction, hh owns agricultural land			0.71	0.364	1.05	0.912
Interaction, hh livestock index			0.91	0.482	0.67	0.276
Interaction, hh business ownership			0.43**	0.006	0.28	0.035
Interaction, hh nonagricultural occupation (%)			1.68	0.229	0.93	0.921

Table 4.2 Continued

	Model 1		Model 2		Model 3	
	Hazard Ratio	p>|z|	Hazard Ratio	p>|z|	Hazard Ratio	p>|z|
Interaction, municipality migrant social capital			1.50	0.781	11.31	0.210
Wald X^2 test: Joint significance			16.12*		14.29*	
Subjects	4,171	4,171	1,835			
Events	331		331		117	

Note: *p<.05; **p<.01; ***p<.001
Breslow method for ties

Table 4.3: Discrete Time Logit Predicting the Likelihood of Nonlivelihood Migration from a Household

	Model 1		Model 2	
	Hazard Ratio	p>|z|	Hazard Ratio	p>|z|
Household characteristics				
HH head is male	0.91	0.723	0.91	0.707
HH head age	1.01*	0.015	1.01**	0.006
HH head education	0.87	0.357	0.89	0.454
Total hh members	1.15***	0.000	1.16***	0.000
HH gender composition (female %)	1.20	0.714	1.43	0.493
Durable assets	1.17**	0.005	1.18**	0.006
Ownership of agricultural land	0.95	0.905	1.04	0.926
Livestock, index	1.06	0.356	0.98	0.924
Members engaged in nonagricultural occupations (%)	2.06	0.078	2.12	0.101
Ownership of business	0.99	0.995	0.97	0.935
Migrant social capital (total hh migrations prior to 1996)	2.63***	0.000	2.60***	0.000
Municipality characteristics				
Disaster affected	0.86	0.606	1.79	0.521
Migrant social capital (avg migrations per hh)	8.05	0.023	10.15*	0.010
Rural	0.97	0.931	-	
Interaction effects with disaster affected				
Interaction, hh migrant social capital			1.24	0.096
Interaction, hh durable assets			0.95	0.750
Interaction, hh owns agricultural land			0.48	0.491
Interaction, hh livestock index			1.25	0.119
Interaction, hh business ownership			1.01	0.977
Interaction, hh nonagricultural occupation (%)			0.62	0.642
Interaction, municipality migrant social capital			0.01	0.226
Wald X^2 test for joint significance			12.05	
Subjects	4171		4171	
Events	100		100	

Note: *p<.05; **p<.01; ***p<.001
Breslow method for ties

CHAPTER V

BRINGING AN ENVIRONMENTAL CATASTROPHE IN

Introduction

Recognition has been made that global climate change may pose a serious threat to the development of vulnerable countries and communities due to the environmental hazards resulting from climate change (IPCC, 2007; Yamin et al., 2005). Increased incidence of hazard events are a likely outcome of global climate change, particularly for the countries of the Global South (IPCC, 2001). Yet, although much attention has been paid to macrolevel associations between development characteristics, including the strength of institutions (Lin, 2014; Neuymayer et al., 2014) and level of economic development (Kahn, 2005; IPCC, 2007; Toya & Skidmore, 2007), relatively little examination has been conducted on how environmental disruptions feedback on macrolevel charcteristics to influence development outcomes (Bui et al., 2014). This study contributes to this general area examining in particular, "two noteworthy gaps" (Liechenko & Silva, 2014:550) in the social science literature on the potential results of climate change: environmental disruptions influence on the distribution of income/consumption and poverty. This study does so in the context of the Hurricane Mitch event of 1998 as experienced in Nicaragua, examining long-term trends up to the year 2009 in poverty, inequality and consumption distribution at the level of the municipality.

Background

For the bulk of the 20th century, political power in the country of Nicaragua was consolidated under the Somoza Presidential dynasty. For all but a few years in the period from 1936 to 1979, President's Anastasio Somoza Garcia and sons Luis and Anastasio Somoza Debayle ruled the country, an era notoriously characterized by corruption, stark inequality, patrimonial politics, and entanglement with foreign interest (Dye & Lose, 2004; Kay, 2010). The beginning of the end for the Somoza dynasty was spelled by a severe disaster event, the Managua earthquake in 1972. The devastating Managua earthquake exceeded the impacts of Hurricane Mitch in measurable ways, both in its staggering death toll (over 10,000) and in the number it rendered homeless (500,000). The earthquake interacted with otherwise increasingly unstable social and political conditions to produce a tumultuous, revolutionary period. The Sandanistas had, by the time of the Managua earthquake, already begun to form a base in certain rural areas of the country by 1972. However, the perceived mishandling of recovery aid by the Somoza leadership legitimized the Sandanistas as a revolutionary force, and following the earthquake, the 1970s featured the rise of the Sandanistas to a national force (Sandino, 2005). In the year 1979, it culminated in bringing the deposing of the Somoza Presidential leadership (Ravborg & Gomez, 2014), and the rise of the Sandanista led government. The decade following the rise of the Sandinistas, however, did not feature increased socioeconomic gains for the country as many had hoped. Instead, the 1980s were characterized by civil war, insurrection, and economic chaos (Gibson, 1996).

The Arias accords, a multilateral peace agreement signed in 1990, marked the beginning of a period of relative political stability and peace for Nicaragua and the

Central America region. The 1990s witnessed Nicaragua's first positive economic growth in decades at a modest average annual growth rate of 1.7%, with gains extending to 1/3 of Nicaraguan's rural districts; areas that had historically lagged far behind urban areas in economic development and human development outcomes (Lane, 2000). Economic gains accelerated during the 2001 to 2005 period, averaging 3.2% annual growth with the gains (Ravnborg & Gomez, 2014; Wiggins, 2007; World Bank, 2008). Researchers at the World Bank attribute much of the gains made in these areas largely to a resurgence of the agricultural sector, driven largely by international demand for Nicaragua's exports crops. Prices for agricultural goods, especially beans, coffee and meat (2008), the products of small producers in rural Nicaragua, rose internationally. In addition, demographic conditions were favorable for the country, as a large proportion of the national population entered labor productive years and contributed economically to their households and communities (WB, 2008)

In terms of poverty, 1993 to 2001 was characterized by a small, but notable decline in the national rate from 50 to 46%. The years between 1998 and 2005 were disruption in the declining poverty trend, as both general poverty and extreme poverty increased slightly over the period (Dijkstra, 2013; WB, 2001). This halting of poverty decline was in spite of an economic growth rate of 3.2% over the 2001-2005 period. In 2005, a decreasing poverty trend returned, in particular in the form of a reduction in extreme poverty in rural areas, occurring to the year 2010 (Dijkstra, 2013). Other indicators of living standards, including crowding, access to water, quality of housing and child school enrollment, exhibited similar trends of improved condition over the last 20 years (WB, 2008). The exception was brief deterioration over the 2001-2005 period

(Dijkstra, 2013).

These economic trends are notable, in and of themselves, as evidence of improvement in economic and socioeconomic conditions not seen in Nicaragua for decades. They should, however, not be overstated. The gains are minor. Poverty remains high in the country and social indicators are generally weak (Dijkstra, 2013; Wiggins, 2007). Inequality remains a structural feature of the country (Dijkstra, 2013), with one estimate in the year 2001 placing Nicaragua amongst the most unequal in the world with a Gini coefficient of 0.55 (Wiggins, 2007). Given that the minor gains in employment and earned wages were largely driven by an increase in the prices of export agricultural crops, they were tenuous and vulnerable to future fluctuations in the world market (WB, 2008).

Findings of a disruption to socioeconomic indicators between the years 1998 and 2005 amidst an otherwise improving trend since 1990 suggest a disrupting influence of the Hurricane Mitch event, given the timing of the event's occurrence in late 1998. Short-run impacts of the Mitch Event are easily apparent; estimates of the gross losses of Hurriacne Mitch on the 1998 GDP made by the International Monetary Fund are 57% (Cardemil et al., 2000). Furthermore, Nicaragua faced constraints on its ability to recover due to economic restructuring in the 1990s. The servicing of international debt hamstrung immediate recovery efforts in the first 5 years following the Mitch event. Investments of reconstruction efforts by the Nicaragua government in 1999 were estimated at $190 million, barely surpassing the $170 million paid to the IMF during the same period as terms of loan agreements (Banco Nacional de Nicaragua, 1999; Lane, 2000). Fortunately, substantial debt relief was granted in 2004 easing these severe

constraints placed on recovery (WB, 2008).

Debt relief was granted in 2004 along with vast sums donated to the recovery effort, including a combined $1 billion in interest-free credit loans to the countries of Nicaragua and Honduras issued by the International Development Association (WB, 1998). The detailed analysis performed by Christopolos et al. (2010) of the recovery of two impacted communities is useful in providing insight into how aid efforts influencing livelihoods in the years following the event may have contributed to variable outcomes across population segments. While the Hurricane negatively impacted livelihoods, in particular "wage employment in horticultural production and food production on sloping lands degraded by the hurricane" (Christoplos et al., 2010, p. S207), at least in the short-term, aid combined with the need for reconstruction led to short-term livelihood creation in the areas of construction, rebuilding infrastructure, along with involvement in the logistics of aid distribution (Christoplos et al., 2010). Long-term aid for the purpose of livelihood generation operated according to a logic that had the potential to alter the consumption distribution of impacted communities. Aid distribution was assigned according to an uneven "picking winners" (Christopolos et al., 2010, p. S207) method of disbursement. The "picking winners" concept emphasizes aiming aid specifically at those who appear most likely to take advantage of the opportunities of economic development, under the assumption that gains made by "winners" would be most likely to be sustainable (Christoplos et al., 2010). This logic made the coffee industry a candidate for targeted aid in the forms of provisions for productive inputs, technological upgrading and rehabilitation of farm-to-markets roads. In the municipality of the Christopolos et al. study, the pick winners approach yielded successes for developing the coffee industry,

and increasing the incomes of those involved, especially for agricultural producers and entrepreneurs with social capital in the form of involvement in cooperative organizations.

As alluded to above, the Hurricane Mitch event had implications beyond acting as an exogenous economic shock, as it interacted with a variety of domestic and international factors at play for the country of Nicaragua. This study seeks to examine the cumulative macrosocioeconomic implications of the Hurricane Mitch event, by examining variation in socioeconomic indicators between Mitch impacted and nonimpacted communities. This study asks, if and how did the Hurricane Mitch event influence long-term trends in poverty, inequality and the distribution of consumption in impacted municipalities?

Literature Review

A good deal of empirical work associated with the hazards vulnerability and resilience literature (Wisner et al., 1994) has examined how social vulnerability characteristics within populations influences exposure to and ability to recover from a natural hazards event. Thus far, however, work extending the implications of social vulnerability to the long-term macrolevel impacts of large-scale disasters are limited (Bui et al., 2014). Yamamura (2013) examines impacts of natural disasters on inequality cross-nationally and identifies only increased inequality in a short-term, 1-year window following disasters, as the increase disappears by the time 2 years have passed since an event. Bui et al. (2014) meanwhile finds increased inequality in the context of disaster impacted communities in Vietnam. Both the work of Bui et al., (2014) and the study of Rodriguez-Oreggia and colleagues (2012) in the context of Mexican impacted communities, find disasters to be associated with deepened poverty.

Aside from the possible influence of this natural hazard, other processes of development associated with time and influence on inequality and poverty outcomes are certainly at play for Nicaragua over this period. The sociological internal development model associated with Nielsen and Alderson (1995) outlines several social-structural features of societies that are associated with development and influence inequality as development in areas progresses. Influenced by the 'Kuznet's curve' (1955), an apparent, inverted-U shaped curvilinear relationship between development and inequality, the model figures development leads to increased inequality during an intermediate period, followed by reduced inequality as developmental processes progress. This process of rise and fall in inequality is primarily due to four occurrences associated with development, consisting of labor force shifts, increased sectoral dualism, the demographic transition, and the spread of education (Alderson & Nielsen, 1999).

Labor force shifts associated with development involve an increased proportion of the labor force participating in the modern, nonfarm employment sectors and a concomitant decrease in the proportion of the labor force involved in the agricultural sector. According to the internal development model, this labor force shift plays into the initially featured increase, peak, and following decrease in inequality, by operating through sector dualism—the difference in income between the agricultural sector and all nonagricultural sectors (Nielsen & Alderson, 1995). The demographic transition figures into inequality in developmental processes, as it causes dramatic shifts in the proportion of the population in the labor productive years. The typical association between the demographic transition and inequality is a rise in inequality in the middle stages of the demographic transition due to a bulged proportion of the population in the labor

productive years. This results in declining returns for participation in lower-earning, labor-intensive occupations. This rise in inequality associated with low-wages at the lower end of the income distribution is followed by a decrease in inequality, as a bulge in the age distribution dissipates with time as the population bulge exits into the labor productive years. Typically, these impacts of demographic processes on inequality are operationalized as the natural rate of population increase and the association most frequently observed between this measure of demographic change and inequality is a positive relationship (Simpson, 1990). Finally, the spread of education associated with development exerts a countervailing force on inequality from that exerted by demographic and sectoral forces associated with development. The spread of education is theorized as broadening the availability of human capital, causing a relative reduction in the salaries of those in high-earning occupations (Nielsen, 1994; Alderson & Nielsen, 1999).

I hypothesize that social vulnerability in the agricultural context of Nicaragua following a period of neoliberal reforms would lead to the Hurricane Mitch event contributing to increased inequality and deepened poverty in impacted communities with large populations of socially vulnerable residents. However, an alternative scenario is also plausible given the vast sums of money in support of rehabilitation and reconstruction efforts. Aid efforts aimed at the socially vulnerable could potentially benefit those in the lower end of the consumption distribution resulting in reduced poverty and inequality.

Method

This study uses a random effects model, employing a difference-in-differences specification, in order to estimate the influence of the Hurricane Mitch event as an exogenous shock at a grouped level. In contrast to a within-municipality, or between-municipality estimate of the Hurricane Mitch effect, the difference-in-differences specification measures the difference between impacted municipalities and nonimpacted municipalities over time (Imbens & Woodridge, 2009). The regression formula within these specifications takes the following form:

$$Y_{mt} = \propto_0 + \alpha_1 T_m + \alpha_2 A_t + \alpha_3 T_m A_t + \alpha_4 X_{mt} + \varepsilon_m + u_{mt} \qquad \text{Equation (2)}$$

According to this specification, A denotes a dummy, designating municipalities affected by the Mitch event; T is a year specific dummy employed for the years 2001 and 2009 to designate the general impacts of time; α_3, the interaction of A and T, measures the effect of the Hurricane Mitch event on the dependent variable. Having lived in an area impacted by Hurricane Mitch is designated at the municipality level, according to INEC's designation in a 1999 household survey of impacted households. In addition, a robustness check of results was performed through the incorporation of a municipality level fixed effect, as represented in the term $\alpha_4 X_{mt} T_m$ added in Equation (3).

$$Y_{mt} = \propto_0 + \alpha_1 T_m + \alpha_2 A_t + \alpha_3 T_m A_t + \alpha_4 X_{mt} + \alpha_4 X_{mt} T_m + u_{mt} \qquad \text{Equation (3)}$$

As outlined in further detail below, fixed municipality effects serve to account for characteristics endogenous to municipalities' susceptibility to hazards, including factors associated with geographic location and unobserved heterogeneity due to factors associated with development.

The dependent variables in these regression models are derived from a measure of

household consumption based on the LSMS survey. The LSMS survey features a range of questions on household expenditures in the areas of food, housing, helath, education and consumer and durable goods (WB, 2001) The INEC aggregated these various household expenditure measures and subjected the sum to transformations to produce a measure of household consumption comparable across household in the country. Transformations included accounting for household size by dividing by the number of household members. Also, regional differences in prices that would make household expenditure levels incomparable are accounted for through the employment of a geographic adjustment factor (WB, 2003).

Dependent variables in the first set of models are levels of poverty and extreme poverty measured at the municipality level, as the ratio of households designated in poverty or extreme poverty and the total number of households in the municipality. Thresholds for households to be categorized as either poor, or extremely poor are determined by the INEC according to cutpoints indicating ability to meet basic needs. Extreme poverty is measured as an earned income below the cost of a purchasing a bundle of food that would provide 2,187 Kcal per day—or 2,489 Cordobas or 237 dollars in the year 1998 (WB, 2003). General poverty adds to the extreme poverty line, an amount to include nonfood consumptions associated with meeting basic needs, summing to a total of an annual 5,157 Cordobas, or 386 dollars (WB, 2003).

A second set of estimations models the influence of the Hurricane Mitch event on consumption shares held by households as grouped according to consumption quintiles in order to examine where possible changes in the distribution of levels of consumption may have occurred. Quintiles are ordered from the household with the least value in the

consumption aggregate (1st quintile) to the households with the highest value in the consumption aggregate (5th quintile), through the use of the STATA "xtile" command. Once households were assigned to quintiles, an income share was calculated as the summed value of the consumption value of all households belonging to a quintile within a municipality and divided by the total consumption of all households within the municipality.

A final set of estimations models inequality at the municipality level through a Gini coefficient. The Gini coefficient estimates the difference between the calculated distribution of income and the uniform distribution that represents equality. The Gini coefficient ranges from 0 to 1, with higher levels of inequality associated with a greater Gini coefficient. The Gini coefficient is calculated at the municipality level through STATA's "ineqdeco" command.

The practice of assigning households within municipalities to municipality level quantiles based on a characteristic, poses two inherent problems related to the size of quantiles. One is an issue presented by tied values. When cases have tied values lying at the cusp of quintiles, assigning cases to one of two spanned quantiles involves the application of arbitrary rules. Fortunately, the issue of tied values proves to not be an issue in this study, largely due to the high precision in measurement of the consumption variable within these data. Household consumption is measured to the hundredths of a cordova, resulting in no tied values of consumption levels for any two households. The other problem inherent to grouping cases by quantiles is the placement of cutpoints when "n" number of cases, divided by "k" number groupings does not yield an integer. In such cases, it is impossible to equally assign the same number of households to each quantile

and arbitrary rules must be employed to ensure a consistent method across all groupings. In this study, the cutpoint for inclusion in a quintile is assigned at the point after the 20th, 40th, 60th or 80th percentile has been passed. This rule results in the number of households in quintiles in municipalities to be at times irregular, with a bias towards a higher number of households being included in the lower-first four quintiles.

In addition to modeling the impact of the Hurricane Mitch event, following the internal development model, this study employs the following predictive variables at the municipality level: the percentage of productive labor engaged in agriculture; average household consumption per capita; and the ratio of the age appropriate population (12-18 years old) enrolled in secondary education. Two controls for the internal development model were unable to be obtained due to data constraints—the population growth rate and sectoral dualism (frequently operationalized as the difference between the percentage of the population engaged in agriculture and the percentage of income derived from agricultural production). As a proxy for these features of internal development, consumption per capita adjusted for geographical differences and inflation is employed as a representation of unobserved heterogeneous characteristics associated with development. In addition, a robustness check for bias associated with the absence of internal development variables along with any other characteristics endogenous to municipalities' susceptibility to hazards, including factors associated with geographic location, municipality level fixed effects are employed as robustness checks for all estimations[1].

Results

Table 5.1 presents models predicting rates of poverty and extreme poverty at the municipality level. Robust standard errors are employed. Model 1 estimating levels of poverty utilizing a random effects, difference-in-differences model, finds a weak effect of disaster exposure in municipality impacted municipalities, with the exposure associated with a reduction in poverty. Time is associated with increased poverty, with both period specific time variables robustly significant and positive. In addition, characteristics associated with the internal development model—average level of GDP, and the percentage of the population in agriculture—are found to be significantly associated with poverty, with the direction of coefficients consistent with the literature. Average GDP is found to be negatively associated with poverty, while percentage of the population engaged in agriculture is positively associated with poverty. Model 2, as a robustness check and employing fixed effects, bolsters the results founds in Model 1. Results are substantively similar, with two exceptions: Significance with time is now limited to the second time variable and the impact of disaster exposure on poverty is now statistically significant to $p>.05$, indicating the disaster is associated with a reduction in poverty.

Models 3 and 4, estimating rates of extreme poverty, utilizing respective random effects and fixed effects models, find no impact of exposure to Hurricane Mitch on extreme poverty levels. Similar to Models 1 and 2, average GDP is negatively associated with extreme poverty, while percentage of the population engaged in agriculture is positively associated with extreme poverty

Table 5.2 presents Models 1, 2, 3, 4, and 5 predicting the consumption shares of respective quantiles 1, 2, 3, 4 and 5, utilizing a difference-in-differences, random effects

specification. Model 1 predicts the consumption share held by the quintile with the lowest level of consumption, and the dependent variable in successive models follows in ascending order, with Model 5 predicting the share of consumption held by the highest consuming, fifth quintile. Time, average GDP, and level of secondary education are predictive of income shares held by quintiles in all models, with one exception: no influence of time on quintile 4. In Models 1, 2, 3 and 4, average GDP is found to be similarly associated for quintiles 1, 2, 3 and 4, with a rise in average GDP in municipalities associated with a decreased consumption share held by each of these respective quintiles. For the highest consuming quintile, 5, as estimated in Model 5, the opposite is the case, with a rise in average GDP associated with a raised consumption share held by this quintile. The level of secondary education in municipalities as measured with a 2009 dummy variable, demonstrates an opposite effect on each of these quintiles. For quintiles 1, 2, 3 and 4, increased education is associated with a larger consumption share held by these quintiles, while it is negatively associated with the consumption share held by quintile 5. Time, as reflected in the 2009 period specific variable, is associated with a raised consumption share for quintiles 1, 2 and 3, exerts no influence on quintile 4, and is associated with a reduced consumption share for quintile 5.

Exposure to the disaster is found to be associated with a statistically significant effect on the consumption share of one quintile, quintile 2. While the indicator of municipalities impacted by Hurricane Mitch is found to be negatively associated with this variable, the interaction with time is positively associated with the consumption share variable. When interpreted together, and incorporating the results of the main effect of time, these predictive variables are indicative of disaster exposure to the Hurricane Mitch

event as associated with a raised consumption share for this particular quintile. The indicator of municipalities impacted by the event is suggestive of an endogenous association between communities likely to be exposed to the hurricane and consumption share held by quintile 2. Municipalities impacted by Hurricane Mitch demonstrate lower consumption shares for quintile 2, but in the context of the Hurricane Mitch event, this reduced consumption share is lessened. Incorporation of municipality level fixed effects as a robustness check indicates the result of an increased share in the 2nd quintile to not be an artifact of the modeling technique, as modeling in this manner yields the Hurricane Mitch event being associated with a positive coefficient of 0.0133, and $p>|z|$ equals 0.0380.

Given another case study's observation (Christopolos et al., 2010) that distribution of livelihood aid in Nicaragua following Hurricane Mitch was issued selectively and according to a picking winners method, I performed a tabulation of households reported having received livelihood and employment aid, by quintiles of household consumption. The data tabulated are based on household reports in the 1999 collection wave, conducted in May and June of that year, approximately 8 months following the event. The tabulated population includes only households residing in impacted areas. Table 5.3 presents the resulting tabulations expressed as percentages of households within a quintile that had received aid. Results indicate aid to be received at a highest rate for those in the quintile #4, followed in successive order by quintiles #1, #3, #2, and #5.

Table 5.4 presents the municipality level Gini coefficient regressed on internal development indicators, time variables and a difference-in-differences estimate of the

impact of exposure to Hurricane Mitch. A period specific effect of time is observable, with the 2009 time variable associated with an increased Gini coefficient. Average GDP is also found to be associated with an increased Gini coefficient, while secondary education is negatively associated with the Gini coefficient. No impact of disaster exposure is observable.

Discussion

Consistent with the literature, internal development factors play significant roles in these municipality level outcomes, as does time. Time itself is associated with gains for the lowest three quintiles. Level of economic development as measured in average GDP is otherwise associated with reduced consumption levels for the lower three quintiles, and increased shares held by the wealthiest quintile. In terms of the Gini coefficient, economic development is associated with an increased Gini coefficient representing inequality. Education also plays an independent role, reducing inequality by raising the income shares of quintiles 1, 2, 3 and 4.

Taken together, results of this chapter's regression analyses indicate a minor influence of the Hurricane Mitch event on the distribution of consumption levels in impacted communities. A marked effect of the disaster on the consumption share held by the second lowest consumption quintile is observable, with the effect indicating gains attributable to the event. Evidence that Mitch exerted influence on consumption levels of the second-lowest consumption quintile in particular, is reinforced by observable impacts of Hurricane Mitch on poverty indicators. Although the Mitch event is not found to exert influence on levels of extreme poverty, it is associated with a reduction in a broader measure of poverty. Finally, models estimating the impact of the Hurricane Mitch event

on the Gini index inequality measure indicate that impacts of exposure to the Mitch event on consumption levels was not so great as to result in a measurable impact on the municipality level Gini coefficient.

These findings break from the pattern observed thus far in the small, incipient literature on macrolevel impacts of disaster events on inequality characteristics and poverty. Whereas the two known studies assessing for poverty effects (Bui et al., 2014; Rodriguez-Oreggia et al., 2013), and one known study assessing inequality in disaster contexts (Bui et al., 2014) observe increased inequality and increased incidence of poverty in these contexts, this study finds the opposite—the disaster event was associated with reduced inequality and poverty.

The minor reduction in poverty associated with the impact of the disaster indicates that in the context of the event, a combination of factors related to the event enhanced the condition of lower- to midearning populations, bringing some past the poverty threshold as estimated by the World Bank. Analysis in this study finds livelihood aid was received most by the lowest four consumption quintiles and most of all by the lowest consuming quintile. Small farm owners likely belonged to this lower-to-midearning population segment. These small farm owners were likely candidates for livelihood based aid efforts that in the context of economic conditions in the years following the event, yielded some success. Efforts were aimed at enhancing the capacity of small producers of export crops, and international demand for export crops in the post-Mitch period rewarded these efforts.

While the Hurricane Mitch hazard event was devastating, it was followed by international economic markets somewhat favorable to the livelihoods on which much of

the rural population of Nicaragua is economically dependent. Improvement in position observable for the bottom-four consumption quintiles, in municipalities both impacted and nonimpacted by the Hurricane, is clearly linked to robust prices of export agricultural goods on the international market (Christoplos et al., 2010; World Bank, 2008). These conditions were fortuitous. Beyond economic conditions being favorable for the population of the country broadly, these conditions played positively to the livelihood interventions instituted as recovery aid in impacted municipalities. The discrepancy between this study's finding of a decrease in poverty associated with disaster exposure and with increased poverty observable in other disaster contexts (Bui et al., 2014; Rodriguez-Oreggia et al., 2013) suggests that had these economic conditions been less favorable and the vagaries of both nature and the international market played negatively to Nicaragua's vulnerabilities, the long-term outcomes from the Mitch event would likely have been much worse for lower-earning segments.

Endnotes

1. The results of inclusion in fixed effects are only reported for models predicting poverty, as these were the only models in which the inclusion in fixed effects resulted in any substantive change in results.

Table 5.1: Longitudinal Regression of Rates of Poverty, Extreme Poverty

	Model 1		Model 2		Model 3		Model 4	
	Coefficient	p>|z|	Coefficient	p>|z|	Coefficient	p>|z|	Coefficient	p>|z|
Year 2001	0.0538**	0.006	0.0250	0.215	0.0263	0.121	0.0095	0.575
Year 2009	0.1847***	0.000	0.1214**	0.004	0.0898**	0.006	0.0739	0.099
Avg GDP	-0.0004***	0.000	0.0000***	0.000	0.0000***	0.000	-0.0002***	0.000
Secondary Education	-0.0129	0.454	0.0113	0.638	0.0035	0.980	0.0139	0.535
Agriculture %	0.2628***	0.000	0.2092***	0.000	0.1615***	0.000	0.1186**	0.001
Disaster municipalities	0.0387	0.138	-		0.0113	0.561	-	
Disaster Impact	-0.0506	0.077	-0.0519*	0.034	-0.0118	0.580	-0.0120	0.537
Constant	0.5699***	0.000	0.5689	0.000	0.2075***	0.000	0.2186***	0.000
R-Squared within	0.4364		0.4451		0.2310		0.2349	
R-Squared overall	0.7177		0.7011		0.4955		0.4895	
wald chi	626.10		23.15		248.24		13.48	
prob>chi2	0.0000		0.0000		0.0000		0.0000	
N	139		139		139		139	
Obs	359		359		359		359	

Table 5.2: Longitudinal Regression of Consumption Share by Quintile

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coefficient	p>|z|	Coefficient	p>|z|	Coefficient	p>|z|	Coefficient	p>|z|	Coefficient	p>|z|
Year 2001	0.1080**	0.007	-0.0031	0.453	0.0076	0.142	-0.0075	0.251	-0.0106	0.417
Year 2009	0.0350***	0.000	0.0380***	0.000	0.0564***	0.000	0.0185	0.188	-0.1595***	0.000
Avg GDP	-2.8E-6***	0.000	-3.4E-6***	0.000	-4.7E-6***	0.000	-2.9E-6**	0.005	1.3E5***	0.000
Secondary Education	0.0080*	0.023	0.0126**	0.001	0.0149**	0.002	0.0209*	0.020	-0.0464***	0.000
Agriculture %	0.0115	0.051	0.0040	0.532	0.0006	0.932	0.0086	0.440	-0.0168	0.380
Disaster municipalities	-0.0035	0.474	-0.0136*	0.020	0.0042	0.579	-0.0108	0.179	0.0203	0.247
Disaster Impact	0.0051	0.354	0.0137*	0.037	-0.0119	0.163	0.0103	0.286	-0.0155	0.414
Constant	0.0927***	0.000	0.1397***	0.000	0.1831***	0.000	0.2443***	0.000	0.3359***	0.000
R-Squared within	0.1323		0.1425		0.1040		0.0700		0.2090	
R-Squared overall	0.1884		0.1751		0.1666		0.0663		0.2581	
wald chi	92.29		65.71		53.72		17.79		116.29	
prob>chi2	0.0000		0.0000		0.000		0.013		0.000	
N	139		139		139		139		139	
Obs	359		359		359		359		359	

Table 5.3: Percentage of Impacted Households Reporting Having Received Livelihood Aid by Consumption Quintile (1999)

Consumption Quintile	HH Receiving Aid
1	21.7%
2	18.9%
3	15.2%
4	26.4%
5	7.6%

Table 5.4: Longitudinal Regression of Gini Coefficient

	Coefficient	p>|z|
Year 2001	-0.0167	0.151
Year 2009	0.1510***	0.000
Avg GDP	1.3E-06***	0.000
Secondary Education	-0.0420***	0.000
Agriculture %	-0.0210	0.202
Disaster Municipalities	0.0181	0.212
Disaster Impact	-0.0181	0.249
Constant	0.2963***	0.000
R-Squared within	0.2688	
R-Squared overall	0.2815	
wald chi	135.20	
prob>chi2	0.0000	
N	136	
Obs	355	

CHAPTER VI

CONCLUSION

Anthropogenic climate change is a potential looming problem for human populations precisely because of its link to increased frequency and intensity of environmental hazards. Projections indicate that hazards will increase in the future and will take a wide array of forms, ranging from slow-onset pressures such as increased water scarcity and encroaching deserts, to rapid-onset events, such as devastating typhoons. Understanding what the implications of climate change means for the living conditions of human populations and its implications for international governance requires explicating how various hazard forms interact with human social processes. Because the environment's impacts on populations occurs through its influence on individual and household level behavior, along with interaction with community and national level political-economic factors, a nuanced understanding of the implications of hazards requires moving between the macro-, mezzo- and microlevels of social action. For this reason, this study examines activity at the three levels of social action while investigating several interconnected social dimensions of rapid onset hazards vulnerability. The dimensions of hazards vulnerability examined in this study are: a) historical developmental processes that have shaped patterns of hazards vulnerability; b) the mechanisms underlying rapid onset hazards vulnerability; and c) implications of hazards vulnerability for development outcomes for communities, given they are subject

to a large-scale natural disaster. A central technique used in this study to bring novel insights into scholarly understanding of natural hazards vulnerability is introducing the hazards scholarship field to theory from other disparate social science fields and subfields including: historical sociology, the interdisciplinary livelihoods field, environmental sociology, migration studies, and the sociology of development.

The motivation behind the choice of topics addressed in Chapter II is an identified need for further understanding the roots of hazards vulnerability in an historical perspective. Two developmental trends noted by scholars within the field of historical sociology are highlighted, as they explicate key historical moments that affected certain groups' susceptibility to natural hazards.

First, Chapter II highlights a shift in social relations with the transition to capitalism in agrarian, peasant societies. The social system of precapitalist, agrarian peasant societies operated according to the "moral economy of the peasantry" (Scott, 1976), elsewhere termed "the subsistence ethic," (Thompson, 1971). Norms, relationships and practices emphasizing the logic of survival and subsistence over market efficiency characterized this social system (Thompson, 1971; Scott, 1976; Wolf, 1969). Within peasant societies, powerful norms of redistribution and reciprocity existed that emphasized aiding those unable to meet basic subsistence needs and those experiencing temporary hardship. In the event of natural events, and agricultural short-falls in particular, these values of redistribution acted to bolster the resilience of those experiencing natural shocks. In addition, distribution of landholdings featured the scattering of plots, a scheme that distributes risk and reduces exposure to natural hazards. With the onset of capitalist relations, norms and values of market efficiency replaced the

moral economy, a shift in social relations that implies the loss of mechanisms that aided in reducing hazards exposure and contributed to the resilience of the peasantry (Polanyi, 1944; Wolf, 1969).

The second historical developmental process with implications for vulnerability highlighted in Chapter II is depeasantization, the erosion of peasant subsistence production, and its replacement with wage employment and economic integration. A number of factors associated with 20th century economic integration have accelerated the process and contributed to subsistence production becoming an increasingly untenable livelihood strategy. Predominant contributing factors include "land grabbing" by powerful economic actors, and the penetration of large-scale agricultural and manufacturing producers. Newly available wage employment in the Global South has taken a range of forms, but especially wage work for agro-industrial firms, and wage employment in the manufacturing and service sectors has proliferated. For relatively wealthy segments of rural populations in the Global South, novel livelihood strategies have resulted in increased income, diversified across a range of sources, while the poorest segment has become increasingly reliant on a limited range of insecure, low-level wage employment. I suggest that in the case of natural hazards, diversified income profiles distribute risk and allow adaptability, while insecure wage employment implies a highest level of exposure and minimal capability for adaptation.

An implication made in Chapter II, that livelihoods—the strategies households engage in to meet their needs within political-contexts and under capital constraints—determine household hazards resilience, is assessed in Chapter III. Chapter III's empirical analysis begins by using cluster analysis to group households according to three

characteristics of the occupations of productive household members: the sectors in which the occupations lie; if the household owns the means of production involved in the occupation; and if the livelihood entailed migration. Clustering yields 7 groupings, 6 of which are characterized by over 75% of household productive labor lying in a particular defining sector/ownership grouping. These are: owned agricultural production; sharecropped agricultural production; agricultural wage employment, manufacturing wage employment, service sector professionals, and business owners. A final last category is characterized by highly diversified livelihood portfolios. OLS regression of change in ownership of household assets over a 6 month period spanning the Hurricane Mitch event finds a loss of households assets for those households that reported having experienced damage from the hurricane and that are involved in the following livelihoods: agricultural wage production, agricultural owned production and households with highly diversified livelihood portfolios. Longitudinal random effects regression of change in assets over a 10 year period finds that while recovery represented in an overall increased level of asset ownership occurred for all livelihood groupings—whether or not damage from the hurricane was experienced—it was associated with lower gains for one livelihood grouping: households reliant upon agricultural wage production and that had experienced damage from the hurricane lagged behind all other livelihood profiles in degree of improved condition.

Results of Chapter III's analysis provides general support for the connections between livelihoods and hazards resilience as proposed in Chapter II. For one, evidence is found of significant differences in change in assets over short- and long-term periods according to livelihoods. In addition, engagement in agriculture appears to be an

important determinant in particular, as can be seen in the short-term losses demonstrated for damaged households that are agricultural own producers and agricultural wage producers. Finally, reliance on agricultural wage production—a prominent replacement of subsistence agricultural production under depeasantization—exhibits lower long-term hazards resilience, in comparison with agricultural own production. This is a key finding of this study, one novel to the field of hazards studies, and one hinting to themes in the works of Karl Marx and Karl Polanyi on wage employment as characterized by high vulnerability to external fluctuations.

Although the focus of Chapter III is on the livelihood forms of households prior to a disaster's occurrence, livelihoods are not static. In fact, this study contends that one of the ways livelihoods variably influence household resilience is in the degree that labor and capital associated with a particular livelihood form can be altered or transferred to another form that is more advantageous under ex-post disaster conditions. Chapter IV examines one particular ex-post household livelihood adaptation response following Hurricane Mitch, and one that speaks to the implications that global climate change may hold for population mobilities.

Chapter IV assesses whether the migration of individuals from households was utilized as an adaptation strategy by those impacted by the Hurricane Mitch event, and assesses for selectivity in this strategy. The results of this empirical analysis find no net stimulating or restricting effect of Hurricane Mitch on international livelihood migration originating from those Nicaraguan households residing in communities impacted by the hurricane. That levels of migration did not increase or decrease in the context of the disaster does not necessarily imply that this was not a desirable strategy for households to

utilize to overcome the shock associated with the disaster. On the contrary, results indicate that the Mitch event was associated with increased positive selectivity according to capital ownership of households. These results suggest that no net increase in migration levels is the result of households not being able to utilize migration to adapt to changing conditions. Households sending migrants under disaster exposed conditions feature positive selectivity according to ownership of physical capitals, equivalent to that of households not exposed to the disaster. Also, selectivity according to possession of migrant social capital increases beyond the selectivity observable in nondisaster contexts. Migrant social capital, the connections to past migrants that facilitate the process of migration, appears to be a necessary requirement to overcome the constraints that Hurricane Mitch placed on initiating migrations. The results of equal, or increased, migrant selectivity according to access to physical and social capital in the context of the Hurricane Mitch event, suggests these livelihood migrations are a reflection of households with greater capital. They possess a wider range of livelihood adaptation responses in comparison with facing capital constraints that limit their ability to adapt their livelihood strategies.

One exception to positive selectivity according to household capital ownership exists in this case. Those households that owned businesses and resided in hurricane damaged communities featured a lowered likelihood of engaging in livelihood migrations. While it could be interpreted that this reduced likelihood represents the inability of households owning businesses to engage in migration, the high level of asset ownership of households featuring this livelihood—the highest of all the seven livelihood profiles examined in Chapter III—renders this interpretation weak. Instead, a more

compelling interpretation is that the association between reduced likelihood of migration and business ownership is less about capital access and its relationship to ability to migrate, and more about migration being less advantageous in disaster conditions for households that own small businesses.

The less advantageous quality of migration for this segment could relate to either or both of the following: a) this livelihood performed well under these conditions, rendering a need for livelihood diversification unnecessary; and b) the management of this particular livelihood under the dynamic conditions of a disaster context required "all hands on deck." The case study performed by Christopolos et al. (2010) on impacted Nicaraguan municipalities finds aid efforts were aimed specifically at entrepreneurs, as entrepreneurs were perceived as potential "winners" whose successes could yield multiplier effects beneficial to the greater community. Not only were small business owners more likely to be the beneficiaries of aid programs, research has found natural disasters to often have a stimulating effect on the commercial sector by driving demand for construction, building materials and home/office furnishings (Zhang et al., 2009).

Furthermore, the circumstances surrounding a disaster context make the operations of a business not routine under these conditions (Runyan, 2006). Rodney Runyan notes in the context of natural disasters, small businesses face conditions of "high consequence, low probability, ambiguity, and decision making time pressure" (2006:12). A business that was, or was not damaged, but residing in a community impacted by a hurricane, could benefit from the employees of the business having a personal stake in the business's success, as household members are likely to be. For all the above reasons, the strategy of migration as a means for household optimization of their livelihood is

likely less compelling in the context of a natural disaster for households that feature ownership of small enterprises.

Chapter II, III, and IV all provide evidence that capitalist development has spelled vulnerability to natural hazards for those lacking the capital necessary to access resilient livelihood strategies. It indicates that not only does capitalist development imply stripping poor agrarian populations of resilience mechanisms, but it doubly conspires to placing them in a position of highest exposure to the negative externalities that are largely the consequences of the economic growth of developed societies. However, the results of analysis conducted in Chapter V at the municipality level challenge what would otherwise appear to be a straight-forward and dire narrative of social vulnerability in the context of global economic integration. Chapter V uses a random effects longitudinal regression model to estimate changes in the consumption distribution, poverty, extreme poverty, and inequality over a 10 year period spanning the Hurricane Mitch event. As opposed to losses observable as being disproportionately borne by those with relatively low levels of consumption, the only statistically significant impact on consumption distribution indicates nearly the opposite—a marked increase in the consumption share held by the second lowest consumption quintile in municipalities impacted by the Hurricane Mitch event. Similarly, municipality level exposure to Hurricane Mitch is associated with long-term reduction in poverty (although not for measures of extreme poverty). Meanwhile, models estimating the impact of the Hurricane Mitch event on the Gini index inequality measure indicate that impacts of exposure to the Mitch event on consumption levels was not so great as to result in a measurable impact on the municipality level Gini coefficient.

At face value the results of Chapter V appear to contradict the finding in Chapter III of a relative decreased condition for agricultural wage producers. In fact, this is not necessarily true. While the tabulations displayed in Table 3.3 do indicate that agricultural wage producers fall in the lowest two consumption quintiles, they do not comprise these segments alone. Other livelihood groupings, including agricultural own producers and sharecropped agricultural producers also lie in these segments, and these livelihood profiles are observable in Chapter III as having made recovery gains similar to that of wealthier households. Reinterpreting the combined findings of Chapters V and III in this light, these results indicate that while consumption distribution gains were made in the second lowest consumptions segments, they were made by households belonging to this segment and were not characterized by their livelihoods being predominated by agricultural wage production. Instead, these gains likely originated from agricultural own producers who were the likely beneficiaries of livelihood aid. These findings thus suggest that livelihoods exert an influence on resilience that operates independent of a relationship with income or wealth.

Three key factors in the positive recovery outcomes observable in this case were debt relief, which was granted in 2004, timing of high prices on the world market for Nicaragua's export crops (World Bank 2008), and the issuance of aid and its implementation by external foreign actors. These results draw attention to two possible mechanisms of resilience to the hazards posed by global climate change: the economic growth associated with expanding integrated global neoliberal economic policies, and foreign aid issue by multilateral, supranational institutions. However, the degree that these are generally reliable, sustainable mechanisms for hazards vulnerability is

questionable. As opposed to these factors originating from internal resilience characteristics of Nicaraguan groups or from a strong state, these factors were arrived at externally and for this reason, have intrinsically problematic characteristics. Though aid supplied and debt forgiven by foreign actors helped in this case, the timing in which these resources were granted, and the methods by which they were implemented, was conditioned by external actors as opposed to a situation in which institutional aid resources originated from the Nicaraguan state. While aid and loans were indeed beneficial to the country, and to its vulnerable populations in particular, they draw the Nicaraguan state further into a condition of "dependency" (McMichael, 2008). Reliance on loans from multilateral aid organizations implies a lack of autonomy for the Nicaraguan state that is problematic for the country's independent pursuit of courses of action to best further its development (McMichael, 2008; Stiglitz, 2003). These external resilience mechanisms also imply risk (Rosa, 1998). Relatively high market demand for export crops is a contingent condition that is fleeting. Likewise, dependence on foreign actors providing relief funding involves the uncertainty that they will do so. In sum, external resilience mechanisms are tenuous ones that, while potentially effective, do not necessarily imply a lack of vulnerability for countries and communities in positions such as Nicaragua. Instead, I propose that truly reduced hazards vulnerability for the people of Nicaragua would derive from reliable resiliency mechanisms, inimical to context of dependency, in which resilience: a) originates from within households; and b) is provisioned by a state's bureaucratic apparatus.

Reliable household resiliency mechanisms, originating from within households, would grant households the agency to pursue various responses given a shock, instead of

rendering them passive subjects to contingent conditions that may or may not result in positive outcomes. While favorable market prices or the beneficence of external aiding agencies may yield household resilience, they are contingent on the behavior of external actors, and therefore imply risk. Contrasting, reliable resiliency mechanisms could take multiple forms such as livelihood diversification, insurance or access to affordable credit. Ultimately, true resilience at the household level means that given a hazard, households possess agency to pursue an adaptation strategy to minimize the risk of a reduced condition.

A state featuring a robust and functional bureaucracy can autonomously supply powerful institutionalized resilience mechanisms. It can allocate relief funds; can facilitate large-scale evacuations; can orchestrate complex disaster response efforts; and can "mid-wife" the recovery of economic sectors (Evans, 1995; Lin, 2014; Wisner et al., 2014). Such a state can also decrease its population's exposure to hazards in various ways: by developing and implementing a robust infrastructure; ensuring a level of quality of constructed buildings; regulating workplace practices; and zoning against construction of homes and buildings in hazard prone areas (Lin, 2014; Twigg & Bhatt, 1998).

A country with a state featuring these qualities and with resident households possessing a range of reliable resilience mechanisms, could be achieved through economic growth in the presence of what Peter Evans refers to as "the developmental state" (1995). There is evidence to suggest that these are not impossible achievements for the underdeveloped countries of the world. The touted, newly industrialized countries of the world demonstrated with their blockbuster economic growth in the 1990s and

2000s (McMichael, 2008), that stagnant, underdeveloped countries of the world have the potentiality to achieve economic development outcomes. Also, the model of development in the Central America region, Costa Rica, has exhibited the possibility of a country's transition from featuring a weak patrimonial state to having a developmental state characterized by a robust, functional bureaucracy that provides its populations decreased exposure to hazards and supplies powerful institutional resilience mechanisms autonomous from foreign actors (Isbester, 2010). However, to assume that these outcomes are anywhere in the near future for Nicaragua would be pollyannaish, as there is a lack of evidence to support that the complex concatenation of factors (Evans, 1995; McMichael, 2008; Stiglitz, 2003) necessary to yield these positive development outcomes are being produced. Further sobering, whether such development outcomes could be accomplished for this and the many other underdeveloped countries of the world, within the context of the Earth's limited resources, without introducing, or exacerbating anthropogenic hazards is an issue every bit as troubling.

In spite of these deepest persistent concerns, this study concludes with pragmatic policy prescriptions to minimize hazards vulnerability for exposed populations within the reality of underdevelopment and anthropogenic climate change. The success of the "picking winners" method is undeniable and therefore should not be jettisoned as a livelihood aid intervention. It should, however, be complemented by aiding efforts targeted at those not likely to be beneficiaries under a "picking winners" logic, and those also likely to be unable by their own volition to access a range of adaptation options. Specifically, there should be aid efforts targeted at providing livelihood interventions for those reliant on low-level wage employment generally, but especially for those reliant on

wage employment in the sector or sectors most negatively impacted by hazards—with weather events, this would typically include the agricultural sector.

Finally, attention should be paid to which industries and sectors postdisaster livelihood interventions contribute. Ideal livelihood interventions would minimize foreign dependence, and would balance participation in a global economic marketplace with contribution to a country's internal industrial structure. Diversification of the industries and markets in which various livelihood interventions are involved would also be beneficial to minimize the risk of the global marketplace producing for households a second devastating and unexpected shock. Achieving aid efforts that succeed in all of the aforementioned ways is a lofty goal, requiring complex, nuanced planning, in addition to effective implementation. Yet, perhaps it is not altogether impossible. The welfare of millions is at stake.

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